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The Atlantic City Meeting.

It seems almost unnecessary to urge our central station readers this year to attend the annual meeting of the National Electric Light Association. The reports as to the preparations indicate a very large attendance at Atlantic City, and the natural attractions of the place appeal this year to a membership that has grown very rapidly of late. It is true that in itself Atlantic City has no great electrical engineering features that might appeal to the curiosity or professional interest of central station managers; but it was long ago discovered that some of the most successful meetings of such bodies are those held in places entirely without attractions of that character. A desirable rendezvous is essential, but the main thing is to offer a programme of useful papers and inviting topics of discussion.

In regard to its programmes the National Electric Light Association has made sharp and distinct improvement in recent years, and moreover has not found it necessary to subdivide itself on a trinitarian basis, like the street railway association. While not losing the strong grasp it has always had on the technical side of the art, it has done more and more to bring within its survey questions of economy, management, rates, securing business, cultivation of new fields and all the problems that belong to the central station commercially considered. And while all the points worthy of discussion may not be raised on the floor of the convention, the larger basis of membership insures that the most casual conversation, with other managers, along the breezy boardwalk, can be made to yield its quota of experience and data. The association is, indeed, to be congratulated upon the manner in which it has enlisted and retains the active support of all that is representative and influential in the art for which it stands, and sees these men at its annual conventions.

The Pike's Peak Plant.

Our Western friends never hesitate to play the limit when it seems good policy so to do, and the remarkable hydro-electric plant which we describe this week is an excellent example of this strenuous logic. It employs the highest head yet attempted —2,200 feet after all deductions for friction of pipes, producing a pressure of close upon 1,000 lbs. per square inch. The mere head would give the plant a claim to most respectful consideration; but in addition it possesses features of exceptional structural interest and typifies two important tendencies of modern hydro-electric work, in that it utilizes otherwise wasted head from a city water system and employs the artificial storage usually incident to water works. The general hydraulic arrangements are those usually followed in high-head plants. The pipe line is carried on moderate gradients over as much of the route as is practicable, and terminates in a nearly straight pressure pipe plunging down a steep slope to the power house and graduated in thickness to meet the increasing pressure. In this instance the lower part of the 21-inch pressure pipe is of ¾-inch steel riveted with external and internal straps to strengthen the joint. The installation of this pipe involved some unusual engineering features, such as the use of a narrow gauge cable railway for its transportation and the anchorage of

the line by bedding it in solid concrete in the rather numerous rock cuts along its course. In this way the line was made secure under conditions that were exceptionally difficult.

The power house, for the site of which it was necessary to cut extensively into the side of the mountain, is of unusual design. As usual, the length is parallel to the pipe line but the tail race runs obligingly under the power house and takes the form of a wide tank into which the service pipes, extending at an angle of 45° from the tapered receiver, can discharge through the nozzles. The shafts of the generators are therefore at the same angle with the axis of the power house, and the machinery is so compactly placed that the generator room, which includes the wheels, has an area of only about 1¼ square feet per kilowatt of capacity. As the water is all utilized so that the capacity is determinate, the station is built without reference to extension. The switchboard is on a slightly raised platform midway the longer side of the building opposite the generators, and from it the whole situation can be taken in at a glance. The most interesting part of the power station is the tail race. At the head used the jets cannot be controlled by valves, and deflecting nozzles must therefore be used. This involves the serious question of defence against the tremendous jets from the deflected nozzles, issuing in this case at the enormous velocity of nearly 380 feet per second. No solid material could long endure under such an impact, hence the extremely neat device of catching the jets in a combined tail race and settling tank, defended on its outer wall by cast-iron baffle plates to take care of the remaining velocity. This method has proved effective in disposing of the velocity matter, and the nozzles can be deflected without any fear as to the results.

One of the curious questions raised in this plant is that of wheel efficiency at such enormous heads. Under test the three wheels now installed showed an average of a trifle less than 65 per cent efficiency, as against 80 per cent or a little better for impulse wheels under ordinary heads. The change is obviously due in the main to the increased frictional losses arising from the extreme jet velocity at impact. The loss is a serious one, for the discrepancy amounts to nearly 25 per cent of the plant capacity, say 750 kilowatt for the whole plant. Whether this loss could be materially reduced by extreme care in shaping and polishing the wheel buckets, and whether the surface could be maintained if produced, are questions of doubt. The condition inevitably raises the question whether it would not be worth while in such extreme cases to utilize the water in two or more stages, in spite of the extra cost of building and operating separate stations. An addition of 700 kilowatt to the salable output by getting back to normal wheel efficiency would cover no inconsiderable extra cost, and besides would probably lower the maintenance of the hydraulic machinery. There are few data on wheel performance under very high heads, but what exist all point to increased losses. Inasmuch as high-head plants are in most respects very advantageous, and in them economy of water is extremely important, it would seem that a somewhat critical examination of impulse wheel efficiency would be in order for the purpose of determining the loss of efficiency with increase of head, and the means if any by which it may be averted. It may turn out that all things considered it would pay best to split up extreme heads into several stages, operating the resulting stations in parallel. In cases like that in hand, the loss of efficiency is so great as to demand critical examination.

Lightning and Lightning Protection.

One of the most interesting sociological facts elicited by the Weather Bureau in its recent report on lightning conductors is that the lightning-rod and the lightning-rod man are not so much in evidence as they were thirty years ago. According to the data afforded by the decennial census reports, the annual value of lightning-rod products fell from $1,374,631 in 1870 to $483,296 in 1900. This decline in the lightning-rod business, in spite of the rapid increase in the number of buildings, is an economic feature of modern history for which various explanations have been offered. Perhaps the policy of those corporations which insure buildings against damage due either to fire or to lightning has been one of the main causes. At all events, it is doubtful whether the average owner of a building has changed his views concerning the efficacy of lightning rods during the past thirty years. Tall chimneys and spires continue to have lightning rods erected upon them. The widespread introduction of the steel building has, of course, rendered the lightning rod unnecessary for the protection of the modern skyscraper. Unless, however, all new buildings were constructed of structural steel, we may be assured of a continued and fairly definite average annual damage to property by lightning.

Not only may we continue to expect loss of building property, but we must also be prepared for loss of life. A person staying within a modern steel office building, is as completely protected from lightning shock as science can indicate, and we have yet to hear of injury by lightning to such buildings, or to those within them. But to persons out of doors during thunderstorms or within ordinary buildings incompletely protected, there must always be a certain risk of injury from lightning, although it is usually a very small risk. The number of persons killed by lightning during the year 1899 in the United States, is stated to have been 563, and the injured 820. The deaths through lightning were, therefore, only about one-twentieth of one per cent of the total number of deaths. Electrical circuits must likewise continue to be exposed to injury from lightning unless they are placed underground. No pole line can claim absolute immunity from lightning injury, however complete its protection may be. At the same time we may reasonably expect to reduce the damage and the risk of damage to a minimum by judicious protection of lines across country, and of apparatus in buildings. Great improvements have already been made in these directions.

It is strange how little precise information is yet in our possession on the subject of the lightning discharges. We have only a very imperfect notion as to the magnitude of the electromotive forces involved. Air, at ordinary temperatures and pressures, has strength to resist about three kilovolts per millimetre between flat parallel electrodes well separated. Consequently, at the same rate, a stratum of air one kilometre thick would call for a total breaking stress of three million kilovolts. This may be an upper limit to the voltage of a vertical lightning flash one kilometre long. At a height of a kilometre, the barometric pressure would be about twelve per cent less than at the earth's surface, and the dielectric strength of the air would be less in like proportion; so that even allowing the strength of the uppermost layers, we would require at the same rate 2.64 million kilovolts. But air stressed to 2.64 kilovolts per millimetre contains 300 ergs of electric energy per cubic centimetre, and if the kilometre lightning flash discharged a surface area of

one square kilometre or released the energy in a cubic kilometre of air at such stress, it would liberate three million metre-tonnes, or about nine million foot-tons of energy. This energy would suffice to bring to an incandescent temperature a flashing cylindrical column one kilometre long and 120 metres in diameter—probably far in excess of the size of ordinary lightning flashes. We are therefore compelled to assume either that a lightning flash a kilometre long does not release the electric stress very far in a radial direction, or that the average breaking stress of the air is less than 2.6 kilovolt per millimetre. If the area of the released column were reduced to a square hektometre, which seems a very moderate discharging area, and the dielectric strength averaged a kilovolt per millimetre, the lowest experimental value between needle point electrodes, the flashing voltage would be 500,000 kilovolts and the incandescent flashing column might still be about two metres in diameter, a more reasonable diameter for a lightning flash.

It is also very doubtful whether lightning flashes are oscillatory in character. There seems to be no experimental evidence as to oscillation, such as a moving camera might produce in photographing a flash. On the other hand, the electric resistance of the flaming discharge path may well be so large relative to the capacity and inductance of the discharging system as to make oscillation impossible, and a single subsiding discharge the necessary condition. In any case, however, the suddenness of a lightning discharge must be as great as would correspond to a relatively high frequency if the discharge were oscillatory; and secondary induced disturbances in local conductors must often be oscillatory. Observers of lightning might do well if they could mount a camera on a suitable axis, and revolve it, with exposed plate, at a reasonably definite rate at night on the approach of a thunderstorm, so as to gain evidence of the duration or oscillation of lightning discharge.

SURGES IN UNDERGROUND DISTRIBUTING SYSTEM.

The last number of the *Journal* of the Institution of Electrical Engineers contains a paper on the City of London Works distributing system. The distributing system is three-phase, at 50 cycles per second, and 10 kilovolts. The high-tension feeders are paper-insulated, three-conductor, lead-sheathed cables. Motor-generators in sub-stations distribute direct currents to the consumption mains, with the aid of storage batteries. The coal consumption is shown to average slightly less than 4 lb. per kw-hour delivered to the high-tension feeders. A research was instituted upon the magnitude of the voltage surges capable of being set up in a distributing cable during the operations of switching. The observations were made with the Duddell oscillograph. A number of the oscillograms accompany the paper. It was found that when a three-conductor feeder several miles in length had its conductors connected successively to the high-tension bus-bars, the maximum induced e.m.f. between a given pair was sometimes about double that of the bus-bars. No appreciable surge occurred at disconnecting. In order to avoid the possibility of resonance it is considered preferable to switch a cable in at normal frequency but low voltage, and gradually to raise the voltage to that of the bus-bars, rather than to vary the frequency during the process. Spark-gaps in the central station are permanently provided between opposed plates or strips of carbon and copper. The sparking distance between them is 4.5 mm. for 10 kilovolts, and it is stated that they will discharge at 12 kilovolts, or on a rise of 20 per cent above working voltage. A non-inductive liquid resistance is inserted in the path of each discharger. There is also a small transformer in the ground circuit which operates an electric bell or other indicating device when a spark discharge occurs, so that the time of the discharge may be noted by the station attendant.

The oscillographic results thus obtained are in conformity with those which have been obtained elsewhere. It is found that there is no liability to dangerous surging when a feeder is disconnected from high-tension bus-bars by an oil switch. That is, the operation of disconnecting a feeder, either under normal load, or under light load, gives rise to but little oscillatory disturbance, either in the feeder that is removed or in the rest of the system. On the contrary, when a feeder is thrown on to the high-tension bus-bars of a station, there is likely to be a surge produced in the feeder, the magnitude depending upon the way in which the contact is made, and also upon the particular phase of the e.m.f. wave at the bus-bars when contact is established. The maximum value of the surge e.m.f. is limited to twice the impressed e.m.f., except in special cases of resonance. Moreover, since the surge is of extremely brief duration, a cable that is capable of sustaining for, say, one minute, a voltage 100 per cent in excess of the normal, should readily be able to withstand a momentary surge voltage of this magnitude. Abnormal conditions, such as spark discharges through faults or defective switches, may, of course, produce surges of much greater amplitude than 100 per cent overvoltage.

A number of interesting diagrams are appended to the paper, showing the oscillographic records obtained over certain telephone circuits, when the letters of the alphabet were spoken into the transmitter. Although these are very interesting and instructive they are very hard to harness to arithmetic, not only because the vocal pitch of the fundamental spoken sounds is not appended, but also because our existing theories of telephone transmission require us to consider one frequency at a time, and practically the mean frequency as a general representative of all. In the records, however, all of the frequencies, fundamentals and harmonics, are engaged simultaneously in a free-for-all scramble, so that the individual behavior of each alone is lost in the crowd. It would seem, however, that the broad vowel sounds won in the race for amplitude, while some of the consonant sounds appear thin and poor by comparison.

The author fairly and squarely discredits the *"CR* law" of telephonic limit. Since the British Post Office was the last stronghold of that law, in telephonic circuits, these official and final obsequies of the so-called law are matter for general felicitation. Of course, no one disputes the empire of the "law" over telegraph circuits, in which the inductance is very small and the capacity very large. In fact, it is admitted to apply fairly well to paper-and-air insulated telephone cables. The discrepancy is in overhead wires. The modern theory of telephonic limiting range, based upon all of the four constants per mile, i. e., resistance, reactance, leakage and capacity, is duly considered and compared with a series of experimentally determined limiting ranges on different types of telephone circuit. These experimental results are both valuable and timely. They offer to the engineer for the first time the data which have been so eagerly sought by practical telephonists for a number of years.

A. I. E. E. Meeting at Milwaukee.

The twenty-third annual convention of the American Institute of Electrical Engineers will be held at Milwaukee May 28 to June 1, with headquarters at the Hotel Pfister and sessions in the Public Service building on Sycamore Street. The programme is as follows:

Monday, May 28.—Address of welcome. Address, President Schuyler Skaats Wheeler. "Repulsion Induction Motor," by Maurice Milch. "Comparison of Two and Three-Phase Motors," by Bradley McCormick. "Direct-Current Motor Design as Influenced by the Interpole," by Charles H. Bedell.

Tuesday, May 29.—"Experiences with Lightning and Static Strains on 33,000-volt Transmission Systems," by Farley Osgood. "Cell-Type Lightning Arrester," by Prof. E. E. F. Creighton. "Protective Apparatus for Lightning and Static Strains," by H. C. Wirt. Standardization Rules. The proposed revision of the existing standardization rules will be reported for discussion by the Committee on Standardization. "Short-Circuit and Ground Currents in Alternating-Current Systems," by Chas. P. Steinmetz. "The Self-Synchronizing of Alternators," by Prof. Morgan Brooks.

Wednesday, May 30.—"Magnetic Properties of Electrolytic Iron," by Prof. Chas. F. Burgess and A. Hoyt Taylor. "Measurement of Temperature by Electrical Means," by Edwin F. Northrup. "The Educational Value of an Electric Test Car," by Prof. Thomas M. Gardner. "The Art of Inventing," by Edwin J. Prindle. "Shunt and Compound-Wound Converters for Railway Work," by W. L. Waters.

Thursday, May 31.—"Electrical Connections for Power Houses," by David B. Rushmore. "Economies Derivable from the Use of Relatively Small Water Powers of Low Head in the Middle West," by Prof. Dugald C. Jackson. "Oscillations and Surges Against Ground in Alternating-Current Systems," by Chas. P. Steinmetz. "Some Fundamental Characteristics of Mercury Vapor Apparatus," by Percy H. Thomas. "Safety Devices for Steam Engines, Turbines and Motors," by Charles M. Heminway. "Some Notes on the Lighting of Churches," by Edwin R. Weeks.

The local committee is Messrs. John I. Beggs, chairman; W. E. Dodds, W. F. Johnson, H. H. Cutler and C. W. Burkett, who have arranged a programme of entertainment, etc.

Programme of the N. E. L. A. Convention.

A partial programme has now been issued for the twenty-ninth annual convention of the National Electric Light Association to be held at Atlantic City, N. J., June 5-8. It is as follows:

"Report of Committee on Rates and Costs," discussion by Charles L. Edgar, chairman, A. S. Knight, Alexander Dow, Robert Lindsay, E. M. Lloyd, R. W. Royce; "Business-Getting Methods," Frank Frueauff; "Report on Theft of Current," C. F. Mordock; "Laws Governing Theft of Current," E. H. Davis; "Fuel Economies," J. H. Hallberg; "Alternating-Current Systems of Distribution and Their Automatic Regulation," Charles W. Stone; "Some Methods Used in Securing and Retaining Business," Norman T. Wilcox, George N. Tidd, George B. Tripp, M. E. Turner, Leon H. Schorck, R. S. Wallace; "Line Construction for Overhead Light and Power Service," Paul Spencer; "Alternating-Current Elevators," W. H. Dickenson, Jr.; "Mechanical Refrigeration," John Meyer; "How to Make a Small Plant Pay," D. F. McGee; "Design and Manufacture of Hydro-Electric Installations as a Whole," E. F. Cassel; "The Edison System of Southern California," R. H. Ballard; "Modern Switchboard Practice with Particular Reference to Automatic Devices," E. M. Newlett; "Report on Protection from Lightning During 1906," Alex. Dow, chairman, C. A. Honnold, Robert S. Steward; "The London Sliding Scale as a Method for the Government Regulation of Public Service Corporation," W. H. Gardiner, Jr.; "Report of Committee on Fire Hazards of Electricity," H. C. Wirt, chairman, C. E. Skinner, A. A. Pope; "Report of Committee on Progress," T. C. Martin; "Higher Efficiency Incandescent Electric Lamps in Central Station Service," Francis W. Willcox; "Mercury Arc Rectifier with Magnetite Lamps for Street Illumination," W. E. Barstow; "The Maintenance and Calibration of Service Meters," William Bradshaw; "Report of Committee to Coöperate with Manufacturers' Advertising Committee," Paul Spencer; "Control of Motors on Electric Light and Power Circuits," H. D. James.

Annual Meeting of the Indiana Independent Telephone Association.

The annual meeting of the Indiana Independent Telephone Association was held in the Claypool Hotel, Indianapolis, May 17 and 18. The attendance was large and the meeting was highly successful in every way. The first, or opening session, was presided over by Vice-President Theadore Thorwood, of South Bend. C. S. Norton, secretary-treasurer, read the minutes of the Winona meeting, where the present association was organized and concluded with a very satisfactory report of the financial condition of the association. Mr. Norton next read the report of the executive committee. All of these reports were so full and replete with the accomplishments of the year that the convention was put in an enthusiastic condition on the start, which condition lasted through all the sessions. President Beers' annual address, read by Mr. A. C. Lindemuth, congratulated the association upon the progress and success of the year. Mr. Beers urged the necessity of all independent companies becoming members of the district branch of the association for the common good, a closer relation and a thorough understanding as to the territory each is to develop to its fullest capacity, and to unite their exchanges into one compact system, under standard rules, uniform system of accounts and the furnishing of a service of standard excellence.

Reports were read from the eleven district vice-presidents giving data as to the growth of the business in their territory.

A vote was taken petitioning the authorities of Indianapolis to allow the local independent system to raise its rates as a modification of the franchise and a precautionary measure against financial embarrassment. A similar petition asked for a franchise in Evansville for the Citizens' Telephone Company.

The Southwestern Electric and Gas Association Convention.

The Southwestern Electric and Gas Association held its convention this year at Galveston, Texas, May 16, 17 and 18, at the Tremont Hotel. Galveston, surrounded by water and continually fanned by soft Gulf breezes, is an ideal convention place at this season and brought out a good attendance. Arrangements for the entertainment of the convention were well looked after by Mr. H. S. Cooper, general manager of the Galveston Electric Company, and chairman of the local committee. The first session was called to order Wednesday morning at 10.30 by President M. M. Phinney, of Dallas, the general representative for Texas, of Stone & Webster. He introduced Mayor H. C. Landes, of Galveston, who read a short address of welcome. This address was responded to by W. T. Edgar, of Waco. Secretary Frank J. Duffy, of Beaumont, then read the list of applicants for membership, of which there were 16 for active and 7 for associate membership, making 23 in all. The active membership of the association (that is, operating companies) is now 83.

President Phinney, in his address, spoke of the enterprise of Galveston manifested on every side in the reconstruction and grade raising that had followed the great storm and disaster of 1900. He hoped the convention might absorb and be inspired with some of this same energy and progressive spirit. During the past year the attempt of the association to establish permanent headquarters in charge of an assistant secretary at Dallas had been defeated by the removal in turn from Dallas of both of the men appointed, so that the office was now vacant. Nevertheless,

if they could get an assistant secretary who would not move away he thought it well to maintain the office.

He expressed his belief that the regulation of public service corporations is a good thing if intelligently done, and plain, simple laws are made. A large number of regulating bills were introduced in each legislature. The legislature naturally looked to the members of the association for information on how the proposed measures would affect their business. He advised for this purpose the formation of a legislative committee to be made up of the best posted and most experienced men in the business. The committee should be prepared to furnish absolutely accurate information on technical and business questions raised by the legislation proposed. Finally they should never lose sight of the fact that they were public service corporations and should impress this on all employes.

Restrictive legislation was frequently started by some local controversy and relief was sought through the State legislature for the real or supposed wrongs in some one town. Each member should, therefore, see to it that local difficulties in their respective cities did not remain unadjusted so as to be made a dangerous State issue.

A nominating committee was elected consisting of Messrs. H. S. Cooper, of Galveston; Frank J. Duffy, of Beaumont; R. B. Stichter, of Sherman, and Samuel Kahn, of San Antonio. Mr. G. C. Gum read a paper entitled "Up-to-Date Methods of Increasing the Business of Public Service Corporations," an abstract of which will be printed next week.

Wednesday afternoon the gas men had the floor for a time with a letter on "Retort House Practice," by Mr. Frederick Egner. After this a discussion of some of the question box queries was taken up. Mr. H. S. Cooper invited all who wished to spend the evening at Garden Verein, an invitation which was taken advantage of later by a large number.

Thursday morning at the opening of the session invitations from San Antonio and Dallas were extended to the next convention. No action was taken, as the matter is in the hands of the executive committee. Invitations were read from Mr. H. M. Littell, general manager of the traction and lighting companies of San Antonio, and from the mayor and Business Men's Club, of that city. Dallas' invitation was given by Mr. Sam Hobson, of the Hobson Electric Company, of Dallas.

A paper on "What is Electricity?" was presented by Mr. S. J. H. White, in which the author took up some theories he had worked out to explain electrical phenomena.

Mr. Frank J. Duffy, manager of the Beaumont Traction Company, read a paper on the "Relations of Public Service Employes to the Public." This brought out a good discussion, which occupied the balance of the morning.

Immediately after the noon meal cars were in waiting to take the whole convention party to visit the grade raising operations and enjoy the interesting spectacle of one of the largest dredge boats in the world pumping its cargo of sand into a long pipe line and discharging it several blocks inland. The grade of the entire southern part of the city is being raised several feet to prevent a recurrence of the tidal disaster of 1900. All this filling is being done by sand dredged by hydraulic process from the bottom of the ocean and discharged in a similar manner.

At 4 p.m. the party having returned to the hotel the convention was called to order and a paper on "Care, Maintenance and Inspection of Street Railway Rolling Stock" was read by Mr. H. S. Cooper. A discussion on care of car bodies in the Texas climate and types of cars followed this paper, and occupied all the time until adjournment.

In the evening the Sons of Jove, which order originated at one of these Southwestern conventions several years ago, held a grand rejuvenation and after parading the streets in costume with the candidates for admission tied to a long rope, as is the custom of the order, initiated a number of new candidates.

Friday morning a paper was read by Mr. F. W. Yensen on "Telephone Engineering Problems." Mr. A. W. Q. Birtwell presented a paper on "Organization and Operation of Purchasing and Supply Departments," which stirred up an animated discussion on the question of employing a regular storekeeper or stock clerk in a small company. An abstract of this paper and of the discussion will be printed next week.

A letter was read from a member asking that some action be taken toward securing better insurance rates for electrically-lighted properties than on those lighted with gasoline vapor or acetylene plants. The matter was referred to the executive committee.

Mr. F. M. Lege, of the finance committee, reported, auditing the accounts of A. E. Judge, treasurer, which showed receipts of $1,211.93 and $713.32 paid out, leaving a balance of $498.61. Secretary Frank J. Duffy made his report, which showed that the active membership had increased from 65 to 83 during the past year. The nominating committee reported the following ticket of officers, who were elected:

President, H. S. Cooper, of Galveston; first vice-president, J. W. McLendon, of Fayetteville, Ark.; second vice-president, J. P. Crerar, of Denison, Tex.; third vice-president, Samuel Kahn, of San Antonio; secretary, E. B. Meginnis, of Dallas; treasurer, A. E. Judge, of Tyler. Executive Committee—H. S. Cooper, J. W. McLendon, J. P. Crerar, Samuel Kahn, M. M. Phinney, H. T. Edgar, J. F. Strickland, R. B. Stichter, F. J. Duffy, E. B. Meginnis. Finance Committee—F. M. Lege, J. J. King, W. H. Young. Advisory Committee—J. E. Farnsworth, H. M. Littell, C. W. Ford, C. H. Dunbar, E. D. Kelley, E. M. Cooper, David Daly, C. W. Kellogg, W. Burns Head.

Friday afternoon a special boat was placed at the disposal of the party by which was taken a trip of about four miles to the entrance to the harbor to see the work done on the jetties.

Mr. H. S. Cooper, the new president, is well known in the street railway field. He was born in Isle of Wight, England, in 1856. In 1876 he became a manufacturer of agricultural machinery in the South and this connection brought him in touch with electrical enterprises, giving him an experience that later made it possible for him to reorganize and place many unstable properties on a profitable basis. His record in this line secured for him in 1893 the position of general manager of the Schenectady Railway Company, including the entire electric and gas lighting and railway service of the city. The system was in bad shape, for the business depression of 1893 had necessitated placing of them in the hands of a receiver. Under Mr. Cooper's management these properties were placed in excellent physical condition and brought up to a paying basis. His next important work was with the Ithaca Railway Company, of Ithaca, N. Y., which was rehabilitated under his management and placed on a paying basis. Mr. Cooper then organized the Electrical Engineering and Development Company of New York and made critical reports on all kinds of electrical propositions for clients, and so added to his already wide experience. In 1904 he accepted the position of general manager of the Galveston City Railway, where he was confronted by some difficult problems. One of these has been the rearrangement of the lines so as to meet the raise in the level of the city from two to twelve feet.

Figures on the Telephone Census.

Some time ago the preliminary figures were given out of the census taken of the telephone industry in 1902 by the Bureau of the Census, Department of Commerce and Labor. The final report is now ready and the Bureau has issued a compilation of the data. The telephonic art has grown so rapidly in the intervening three years, the figures now possess value chiefly for purposes of comparison; but it is the intention to secure such returns every five years instead of once in a decade, as now. The report prepared by Mr. T. C. Martin, under the direction of Mr. W. M. Steuart, chief statistician of manufactures in the Census Office, contains also the figures of the telegraph industry, electric fire alarm systems and police patrol systems.

The statistics of the telegraph and telephone industries of the United States were first shown in the census of 1880. At that time telegraphy had been growing steadily for nearly 40 years and telephony was in the formative stages of development. Since

then, however, telephony has progressed to such an extent that it has surpassed telegraphy in physical and financial magnitude. In 1902 the telephone systems operated more than three-fourths of the wire mileage reported for both telephones and telegraphs, gave employment to seven-tenths of the wage-earners, paid more than two-thirds of the wages, received more than two-thirds of the total revenue, and paid more than two-thirds of the total expenses.

In 1902 there were 3,157 commercial systems, 994 mutual systems and 4,985 independent rural lines. For the commercial systems the mileage was 4,779,571, and the number of telephones, 2,225,981; for the mutual systems the mileage was 70,915, and the number of telephones, 89,316; and for the independent lines the mileage was 49,965, and the number of telephones, 55,747. In connection with the commercial and rural systems there were 10,361 public exchanges. The pay stations numbered 80,870, of which 32,477 were automatic.

The number of salaried employes engaged in the telephone service was 14,124, and the average number of wage-earners, 64,628. The amount paid in salaries was $9,885,886 and in wages, $26,369,735. Although there were only 44 Bell systems in 1902, they reported about seven-tenths of the wire mileage for all telephone systems, more than one-half of all the telephones, and three-fifths of the messages or talks during the year. They employed over seven-tenths of the wage-earners and paid almost four-fifths of the wages.

The number of messages or talks reported for the year was 5,070,554,553; of these 4,949,849,709 were local exchange calls and 120,704,844 were long-distance and toll calls.

Ohio led in the total number of messages, with 558,707,801; and Illinois was next with 541,161,932. In long-distance and toll traffic Pennsylvania was first, with 20,409,621 messages, and New York was a close second, with 20,367,024. The greatest number of local messages, 547,238,743, was reported for Ohio, and the next largest, 535,744,349, for Illinois.

The report shows that on the average there was one telephone to every 34 persons, that each person talked 65 times a year, and that each telephone was used 2,190 times. In 1900 there were 1,157 incorporated urban centers with 4,000 or more inhabitants. Of these 1,002 were provided in 1902 with telephone systems of some description. San Francisco, with one telephone to 9 persons, was the best telephoned city in the United States in 1902, while Cleveland ranked second, with one telephone for every 16 persons; and Boston was third, with one telephone for every 19 inhabitants.

The average revenue per telephone amounted to $37.50 and the average per message, to 1.7 cents, while the average operating expense was $24.56 per telephone and 1.1 cent per message. Reports were received for one system in Alaska, one in the Philippines, and 7 in Hawaii. For these 9 systems there was an aggregate of 5,518 miles of wire, 2,891 telephones and 3,887,925 messages.

In the report a table is given showing the telephone statistics as of January 1, 1905, for the United States and Europe. The number of telephones for the United States was 3,400,000 and the number of Europe, 1,485,784.

The commercial telegraph systems of the country owned and operated 1,318,350 miles of wire in 1902. In addition there were 16,677 nautical miles of submarine cable. The 25 systems had an investment, or capitalization of stocks and bonds, of $162,946,525; a total revenue of $40,930,038; and total assets of $195,503,775. A sum amounting to $15,039,673 was paid in salaries and wages to 829 salaried employes and 26,798 wage-earners.

The railway telegraph systems were reported by 684 companies. They employed 30,336 operators and dispatchers, to whom $20,040,730 were paid in wages. The number of messages sent during the year for railroad business only was 201,743,756 and the number of commercial messages was 4,474,593.

The report contains an interesting chapter on the employment of the telegraph and telephone by the Government. It shows the statistics for the telegraph and telephone service of the Signal Corps in the United States, in the Philippines, and in Alaska, and discusses the use of telegraphy and telephony in the work of the Weather Bureau and the Life Saving Service.

Electric fire alarm systems were installed as early as 1852 and by 1902 there were 764 such systems in operation. The fire alarm systems were distributed through 48 States and Territories, although they were found chiefly in the older and more densely populated sections. The largest number, 106, was reported for Massachusetts and the next largest, 70, for New York.

The practice of putting the fire alarm wires underground has increased rapidly during late years, and more than one-fourth of the 39,635 miles of such wire was underground in 1902. There were 37,832 signaling and annunciating boxes and 1,900 special telephones for use in connection with the fire alarm service. During the year 1902, 85,070 fire alarms were turned in through these boxes and telephones. Of these alarms 12,794 were credited to New York 9,491 to Massachusetts and 9,027 to Illinois.

The combination of the telegraph and telephone as an auxiliary to the police force was first introduced in 1880. In 1902 the police patrol systems were distributed in 32 States and the District of Columbia, most of the systems located in the States with the greatest number of large cities. Massachusetts is credited with the largest number, 28; and New York ranked second, with 14.

There were, in 1902, 148 police patrol systems, with 26,350 miles of wire. The signaling boxes numbered 9,476 and the telephoning boxes 1,170. Over these instruments 40,626,505 police calls were received or sent. This gives an average, per box or station, of 3,816 messages during the year, or a daily average of more than 10 calls. The use of the telephone predominated, the number of telephonic messages being 23,393,812, as compared with 17,232,693 of all other kinds.

Kings River Power Enterprise in California.

The Kings River Power Company is planning to expend upwards of $8,000,000 in developing the large water power possibilities on the Kings River, near Fresno, Cal. The company is composed of capitalists interested in the Edison Electric Company, of Los Angeles, and the Pacific Light & Power Company (one of H. E. Huntington's companies), also of Los Angeles. It is said to be backed by E. H. Rollins, of Boston, and N. W. Harris & Co. and Ladenburg, Thalman & Co., of New York.

The Kings River Valley is the second place the Edison people have looked to in central California as a profitable opportunity of investment. They are now completing the erection of a large power plant on the Kern River, from which power will be taken 116 miles to Los Angeles. Five other plants have been planned in the Kern Valley.

The power developed in the Kings River Valley will be entirely used in central California. Four power plants, each to cost $2,000,000, are to be located on the Kings River. The first will be on the river between Trimmers and Maxon's, to which point the country road already reaches. The second will be at the junction of Mill Creek with the river; the third will be at the junction of the middle and south forks of the river, and the fourth at the junction of Boulder Creek with the south fork of the river. The latter point is the final point of the Ellery survey for the State highway.

These power plants are to be constructed in the order named, during several years to come. Work will begin this summer on the one above Trimmer. About four miles above Maxon's the company is to build a $20,000 bridge to cross over to the south and east side. From this bridge to the fork of the river is a distance of 30 miles, and the company expects to have a roadway for the entire distance within the next year. Already the first 12 miles are done, and a force of 40 men will be put on immediately to push the work on the rest of the way at a cost of $2,000 a mile. Work on the bridge will begin as soon as the supervisors let the contract for the county's share of the improvements.

The total capacity of the company's four power plants will be close to 150,000 hp, of which the first one will furnish 40,000 hp. Chief Engineer F. C. Finkle, of the Edison Electric Company, states that all the power will be used in the San Joaquin Valley development, probably a large portion being used for electric railways that will eventually traverse the valley.

Brooklyn Applied Science Reference Library.

The Applied Science Reference Room of the Pratt Institute Free Library (Ryerson Street near DeKalb Avenue, Brooklyn) has for its object the aiding of those engaged in any trade or industry, irrespective of any connection with Pratt Institute. Hundreds of questions arise every day, in the factories and shops of a city, which could be answered from some printed page. It is the intention of the Reference Room to supply this need as far as possible, sometimes with books, very often with periodicals or transactions, and again with trade catalogues.

In the room set aside for this work in the Free Library of Pratt Institute are taken nearly a hundred trade and scientific papers, giving the latest news of the industrial world. There are besides over fifty of the labor union papers, of which a file is preserved. The most important of the periodicals are bound, and these bound files contain much material that can be found nowhere else. The publications of the U. S. Patent Office are kept here also and are used daily. The collection of books includes up-to-date publications in various industries, such as electrical engineering in all its branches, plumbing, manufacture of textiles, industrial chemistry, gas engines, the making of cement, and so forth and so forth. The books in this room are not allowed to go out, so that anyone coming is sure to find the book he wishes to refer to, if it is a part of the collection. The Library has, however, a good collection of books in these subjects for circulation, often duplicates of the books in the Applied Science Reference Room. The room is in charge of Mr. Edwin M. Jenks, whose work is to help those who are looking up any question that lies within the province of this room.

A large collection of trade catalogues furnishes the very latest information in many lines, and is being enlarged constantly. The Library will get any trade catalogue in print, at the request of any user of the Library, if it is obtainable. One new feature of the room is a collection of mounted cuts of machines and mechanical devices. These may be used in the room or taken away to work with, if desired. A man looking up a new form of chuck, for example, will find a score of cuts showing different chucks, and among these may well find some that will be of service to him.

Men studying in the evening schools, those preparing for civil service or other examinations, lawyers, and men of various interests will find this department of use. The Room is open every day except Sunday, from 12:30 p. m. to 9:30 p. m., and can be used between 9 a. m. and 12:30 through the Library office.

Electricity in Market Gardening.

Experiments of much interest in relation to the electrical stimulation of vegetable growth are now being carried on by Hon. Warren H. Rawson, of Boston, at his large market gardening establishment in the suburban town of Arlington, Mass. Mr. Rawson is one of the best known market gardeners in the vicinity of Boston, and for a long time he has been greatly interested in the problem of accelerating vegetable production by electrical means. He has employed the arc light with success in expediting the growth of vegetables, and the latest development in Mr. Rawson's study of how best to promote thoroughly scientific market gardening, consists in the introduction of electric currents into the vegetable beds themselves, and thus far the results obtained have been sufficiently successful to render them full of significant interest.

In November, 1905, Mr. Rawson, acting in connection with Mr. Reuben Le Baron, supervisor of wires, and a practicing electrician in the town of Arlington, began to experiment with currents of exceedingly small magnitude in the lettuce beds of one of the largest greenhouses on his Arlington estate. The soil had been previously sterilized by heating. It was found that if a copper plate was sunk in the loam and fertilizer of the bed at one end of the house, and connected by an overhead wire to a zinc plate sunk in the bed at the other end, a current measurable on a milli-ammeter flowed constantly through the wire, and a potential difference of about 0.5 volt was found to exist between the terminals. No current was supplied from any outside source; the entire flow occurred as a result of the chemical action of the ammonia and other salts in the bed upon the zinc plate. The bed acted simply like a large battery cell and the current measured varied in value from about 0.4 milli-ampere to almost 15 milli-amperes.

One of the beds in the house was separated from the bed in which the plates were sunk, in order to compare the growth of the electrically-stimulated plants with the growth of plants subjected merely to the usual gardening care. It was found that the electrically-treated lettuce grew enough faster to be ready for market a week ahead of that in the ordinary bed, and the heads were also larger in size. The saving of a week's time in this way means a considerable financial gain to a large market garden, where a single greenhouse may contain from 30,000 to 40,000 heads and have an operating value of $40 or $50 a day. The earlier completion of a crop also releases the bed just that much sooner for further production.

The same general treatment is being applied to the production of cucumbers, and while the experiments are still in a rather early stage, it has been found that the yield of the bed has been considerably increased, and the foliage of the vines has been much augmented.

Care has been taken to treat the compared beds alike, with the single exception of electrical application. The experiments have been tried in three different sized greenhouses, the largest being 400 ft. long and the smallest about 100 ft. The width of the beds is about 13 ft. each, and the depth approximately 2 ft. Of this depth, about 1 ft. consists of manure, which is strongly ammoniacal. The size of the plates used has been varied more or less, and the composition of the soil has been found to have considerable influence upon the results. At the time of the writer's visit the 400-ft. house was equipped with a ½-in. zinc strip at the end of one bed, connected to a No. 16 wire running through the house to a copper terminal which consisted simply of a single bare wire of No. 16 size sunk in the bed at the opposite end from the zinc terminal. An ammeter gave a reading of 4 milli-amperes. Cucumbers are being raised in this bed. In some cases it has become necessary to cut down the current by decreasing the plate area, in order to avoid stimulating the crop to a rank growth. In other cases plates 12 in. by 10 in. in area have been used. It is certainly interesting to observe the current flow under the conditions prevailing.

Prof. George E. Stone, of the Amherst Agricultural College, has become greatly interested in the experiments at Arlington, and a thoroughly scientific study of all the conditions and phenomena is now in progress. Readings are being taken of the current flow, the size of the crop is being recorded, and all the important facts which might have a bearing upon the production rate and comparative results are being recorded with care. The whole subject is, in this country, in its infancy, and there is room for an exhaustive study of the different factors which influence the vegetable growth. In many quarters the idea prevails that current is applied externally from the mains of the local electric light and power circuits, but such is not the case. A great deal remains to be found out as to the proper size of plates for various soils and kinds of product, the best current to use, the effect of temperature, moisture, etc.

At first blush it seems almost impossible that a current of a few milli-amperes spread out in sheets over a cross-sectional area of about 26 sq. ft. and a bed 400 ft. in length could produce enough chemical action or stimulation of the roots of the plants to make any perceptible difference in the results. The experiments have gone far enough to satisfy the investigators that there is a stimulus to the growth, however, and it is highly probable that in the not distant future a notable gain in the knowledge of forced market garden production will be enjoyed by the agricultural world. The only expense seems to be the cost of installation, which is a very small matter as thus far practiced.

Douglass Burnett.

Douglass Burnett was born April 6, 1872, in Brooklyn, N. Y., and received his primary education at the Juvenile High School of that city. After four years in the preparatory department of the Brooklyn Polytechnic Institute, he passed four years in the scientific course of that school, specializing in chemistry, and in 1890 was graduated with the degree of B. S. The following year he took a post-graduate course in electricity. During an illness of Prof. Frost, Mr. Burnett had charge of the chemistry classes of the Brooklyn Polytechnic, and at another time had charge of the physics classes during an illness of Prof Sheldon.

At the formation of the Manual Training High School in Brooklyn, Mr. Burnett was appointed instructor in science and latterly had charge of the classes in physics and chemistry. After occupying for a time the position of assistant instructor in chemistry at Pratt Institute, Mr. Burnett for five years was instructor in charge of the evening classes in physics at that Institute. In November, 1904, he entered the employ of the Edison Electric Illuminating Company of New York, and after serving a short time as a clerk in the inspection department, became inspector of isolated plants in New York City and later was made superintendent of the "Annual Survey," which embraced making tests of customers' installations and testing the feeder

DOUGLASS BURNETT.

and main systems. In 1897 he became assistant general agent in charge of the wholesale department, with charge of the canvass for service to new buildings and of all cases involving isolated plants. The duties incident to this work required an intimate knowledge of existing lighting and power conditions and requirements in all the large buildings of New York, and involved the preparation of detailed estimates as to the service and current cost, together with the direction of tests of meter and power equipments and elevators, as well as an intimate knowledge of steam heating, steam and hydraulic elevators and steam and gas engine performances. Among the duties were the preparation of complete electrical specifications for building equipments, and passing upon specifications for plants, equipments, elevators and motors.

On February 1, 1904, Mr. Burnett was appointed manager of the electrical department of the Consolidated Gas, Electric Light & Power Company, of Baltimore, Md., which position he now occupies. In this position he has had particular charge of questions of policy of the company in its relations with the public. He assumed his duties less than a week before the great fire of 1904, and thus had to meet a number of new conditions imposed by the stress of the emergency. From a system with 3,000 customers at that time, the business has increased to one of over 6,000 customers, and there has been an increase in the connected installation from 187,000 to 425,000 16-cp lamp equivalents, the increase in power service being from 2,200 hp in motors connected to 9,000 hp. This substantial increase has been secured in spite of very active competition with the gas company, and a very much more active competition with another electric light company established about the time of the fire.

Mr. Burnett is the inventor of an apparatus known as the Burnett luminometer for the measurement of illumination. He has delivered many lectures on scientific and engineering subjects before the Brooklyn Institute of Science and Arts and other bodies, and has presented papers before the American Institute of Electrical Engineers (of which he is a member in full standing) and the Association of Edison Illuminating Companies, and contributed articles to the technical press. At the time of assuming his present position, he was vice-president of the New York Electrical Society.

CURRENT NEWS AND NOTES.

PROTECTING NIAGARA.—Governor Higgins, of New York, has vetoed the Foelker bill, for the "protection" of Niagara, and in his memorandum says: "The legislative intent doubtless was to help save Niagara, but the expression of such intent by this bill is not felicitous. Approval thereof on my part would under no conditions place the slightest restriction upon the power companies or upon future legislatures, and it might have a diametrically opposite result from that intended."

STREET RAILWAY ASSOCIATION.—Secretary Swenson has issued a circular calling attention to the existing conditions of individual membership in the American Railway Mechanical and Electrical Association, as sketched in a further letter from Mr. S. W. Mower, the secretary and treasurer of that body, which has become a constituent of the larger American Street and Interurban Railway Association in its engineering branch. It all looks very cumbrous and complicated, but doubtless works out easily as a plan for confederating the various interests brought together for co-operation. The change made is that all old members of the Mechanical Association become eligible for associate membership in the engineering branch of the larger, comprehensive body, with dues of $5 each.

CIVIL SERVICE POSITION.—A competitive examination, under the auspices of the Civil Service Commission, for the position of mechanical engineer in the Bureau of Filtration of the City of Philadelphia will be held at room 875, City Hall, Philadelphia, on Saturday, June 2, 1906, at 10 a.m. Applicants must be citizens of the United States, under 35 years of age, and must be graduates of Lehigh University, University of Pennsylvania, Massachusetts Institute of Technology, Troy Polytechnic Institute, Stevens Institute, or other schools of equal grade. They must have had at least two years' experience with steam plants and pumping machinery, preferably pumping stations. The salary is $250 per month. Blank forms of application may be had at the office of the Civil Service Commission, 875 City Hall, Philadelphia, upon personal application by residents of Philadelphia and upon application by mail by non-residents. These must be filed, properly executed, on or before May 28, 1906.

DINNER TO COMMISSION.—The National Civic Federation gave a dinner on May 21 at the Park Avenue Hotel, New York City, to the members of its commission sailing this week to investigate municipal ownership in England. Justice Gaynor, of Brooklyn, gave an unexpected turn to affairs by assailing the recent merger of traction systems in New York City as "dishonest enough to shock the moral sense of the people of the entire country." President August Belmont, of the Federation, responded warmly to this assault and said: "I want to repudiate right here, in the most unqualified language, this insinuation that I or my associates manage these corporations in any other spirit than that of honesty or of correct purpose and with any other view than that of complying with every letter of the law. But I do think that every corporation and every corporate manager is entitled to be heard in court first and then his action shall be tested after the verdict of the court and not before. You know to what I refer and therefore it will not be necessary for me to add anything and I am sorry that I have had to make this statement."

TYPHOON IN LUZON.—A severe typhoon struck the Island of Luzon last week and advices from Manila state that telegraphic communication was interrupted in all parts of the island.

USE OF NATURAL GAS.—The Shreveport, La., Traction Company informs us that it is now operating its system with natural gas under its five horizontal return tubular boilers of 150 hp each. It is estimated that the monthly consumption of gas will approximate 7,000,000 cu. ft. The company uses a boiler gas regulator which keeps the steam at about 120 lb. pressure, allowing a variation of less than 2 per cent, regardless of load. Forty burners to each boiler were installed.

THE FRANKLIN MEDAL.—A cable dispatch from Paris of May 19 says: "At to-day's meeting of the Council of Ministers M. Bourgeois, Minister of Foreign Affairs, presented the medal given by the United States to France in commemoration of the Franklin anniversary. The council decided to send a message of thanks to President Roosevelt and the American nation and also to establish a special section in the Mint, where the medals commemorative of Washington, Lafayette, Paul Jones, Franklin and others connected with the early ties between France and the United States will be deposited."

WESTERN SOCIETY OF ENGINEERS.—The electrical section of the Western Society of Engineers held its last meeting of the season in its rooms in the Monadnock Block, Chicago, Friday evening, May 18. The programme consisted of an interesting paper by Mr. H. R. King, of the Western Electric Company, in which he described in detail the huge new shops of the company at Hawthorne, near Chicago. These shops have been in the process of construction for the last two years, and provide for the employment of about three thousand people. The lecture was well illustrated by lantern slides showing the construction of the buildings, special machinery employed and other features of technical interest.

OPENING OF SIMPLON TUNNEL.—At Domodossola, Italy, on May 19, the new Simplon tunnel, whose trains are to be operated electrically, was opened by the King of Italy. The Simplon tunnel is 12¼ miles long, and is the longest in the world, the next being the St. Gothard tunnel of about 9½ miles. It consists of two parallel tunnels, each for a single line of rails placed about 52 ft. apart from center to center. One terminus is at Brieg, in the Rhone Valley. The Italian terminus is at Iselle. Italy and Switzerland ratified the convention providing for the construction of the tunnel at the end of 1896. The cost of the tunnel was estimated at $14,000,000; $10,000,000 was to be borne by the Jura-Simplon Company, of Switzerland, $3,000,000 by the Swiss Government, and $1,000,000 by Italy. Operations were commenced at both ends in the autumn of 1898.

CHIEF ELECTRICIAN CURTIN.—Letters of commendation have been sent by the Secretary of the Navy to officers and men who distinguished themselves during the great disaster at San Francisco. Of the enlisted men commended Chief Electrician Curtin, of the Pike, is especially honored. After doing all he could to assist in fighting the fire, Curtin established an emergency hospital, now called the Curtin Hospital, and for days managed to obtain the medicine and other supplies required to care for as many at 300 patients daily. After recounting this remarkable achievement, Acting Secretary Newberry's letter says: "The department cannot too highly recommend you for your extraordinary display of energy and resource. It must be a pleasure to the public, as well as to the department, to know that the personnel of the United States Navy is composed of men of your character, who only need an opportunity to show their true worth."

HOTEL TELEPHONES.—It is becoming a common thing to find a telephone in every hotel bedroom. There was a total of 25,000 city calls registered at the new Hotel Astor, New York City, for the month of April, 1906, and for the same month 2,500 suburban and long-distance calls appear upon the record. If the other months show similar totals, the aggregate number of calls of all kinds, exclusive of those coming in, for the year, would be 330,000. The total revenue from telephone use is something like $50,000 annually. In February there were 75 Philadelphia calls, 50 Boston and 503 Jersey City. The hotel does a large telephone business with itself. There are 5,000 interior calls a day, for practically every need or desire of a guest is attended to by telephone. Guests are talked to by telephone as much as they talk. There is an average of 1,000 incoming calls a day, or 365,000 a year. Hundreds of reservations of rooms are made daily by telephone, and thousands of inquiries on every conceivable subject, from the sailing of ocean liners to the price of corned beef hash, are expeditiously answered over the wires. The cashier's desk in every dining room is provided with an instrument, by which guests can retain a table for any meal. Every baggage room is similarly equipped.

INVESTIGATING OPERATION.—A special correspondent of the New York *Tribune* writes from London as follows: "The American experts now occupied in investigating the practical operation of public and private ownership in British towns have the virtue of reticence. There are no premature disclosures of opinion. They are making a close study of the plants and accounts of twenty-four street railway, electric light and gas undertakings, twelve under public and twelve under private management, and they are awaiting the arrival of the main committee of the National Civic Federation this month before tabulating the results or instituting a comparison between the two systems of ownership. Their own work is to be scrutinized by their American associates and a series of visits paid to various towns where local authorities and company officials can be consulted. It may be a month or six weeks before the labors of the engineers and accountants can be revised and completed; and when the facts are summarized there will be various interpretations of them, for the committee includes hearty supporters and strenuous opponents of what is known as municipal socialism. Meanwhile, the experts on the ground are cautious in discussing any branch of the subject, since they know that their own processes are to be investigated and revised before any conclusions are based upon them. If the commission does nothing else, it will establish a new American record for silence, self-restraint and moderation in controversial matters."

COOLING THE SUBWAY.—Keeping the New York Subway road cool in summer has been a great problem. A plan has now been worked out, not for cooling the air, but changing it. To exhaust air between stations two devices will be used, automatic valves and electric fans. The valves will be operated by the trains themselves. These valves open outward only under the increased pressure of air caused by passing trains. An outrush of the heated air between stations is thus produced, which of course induces an inflow of surface air at the stations. The greater the number of trains passing the greater becomes the volume of air removed. For the stretch between Brooklyn Bridge and Columbus Circle there are to be fourteen of these outlet chambers. The engineers recommend that the chambers be constructed as valve and fan chambers combined, the valves to be always in operation, but the fans to be used only for the twelve night hours, or for excessive heat or emergencies. The discharge of air from these chambers will be through gratings in the sidewalk after the air has been passed through cycloidal tubes to diminish its velocity. If these sidewalk gratings prove unpopular, however, ornamental chimneys 10 ft. high can be provided to discharge the air high above the street. The valves and fans together will be able to effect a complete removal of air throughout the Subway once every thirty minutes, it is said. If the fans and louvres are to work at their highest efficiency more openings for inflowing air will have to be provided at the stations. To increase these openings it is proposed to cut out 6,000 square feet of vaulting at various stations and substitute gratings, with copper pans underneath for drainage.

CHICAGO CABLE LINES are among the last of their kind in the United States. Plans have now been completed for their immediate change to electricity.

ATLANTIC CITY EXHIBITS.—The American Diesel Engine Company is an addition to the long list printed last week of exhibitors at the National Electric Light Convention in June.

A HALL OF INVENTIONS is proposed for the Jamestown Exposition, where undeveloped inventions can be exhibited, the belief being that possibly some new arts and appliances may thus be brought to light.

A. I. E. E. IN TORONTO.—At the annual meeting of the Toronto branch of the American Institute of Electrical Engineers, the following were elected: Chairman, Mr. R. G. Black; vice-chairman, Mr. K. L. Atkin; secretary, Mr. R. T. MacKeen. Executive committee, Messrs. W. A. Bucke, H. W. Price, W. G. Chace.

LIGHTING IN COSTA RICA.—An electric lighting contract has been awarded by the municipality of Punta Arenas, Costa Rica, to William F. Teller, an American connected with the San José Electric Company, who will transfer it to the newly organized Punta Arenas Electric Light Company (capital, $27,900 gold), which will install the plant.

CLEVELAND ELECTRICAL CONTRACTORS are looking forward with much anticipation to the sixth annual convention of the National Electrical Contractors' Association, to be held there July 18, 19 and 20, and a local committee is already working out a programme of entertainment for the visitors. At the Boston convention last year the statement was made that they would have a hearty welcome when they went to Cleveland in 1906, and those in charge of the arrangements will use their best endeavor to see that the promise made in Boston is fulfilled. The social feature will be emphasized.

GOVERNMENT CABLE—At Washington, on March 16:—Secretary Taft to-day urged before the House Committee on Interstate and Foreign Commerce the military necessity of a Government cable to Guantanamo, Cuba, Porto Rico, and the Isthmus of Panama. "We are proceeding upon the theory that we are to fortify the Panama Canal," he said. "We have already had a report from the artillery and engineering board as to the fortifications to be made there. It is said the canal ought to be neutral, but it will be necessary to have forifications to protect it against those who may not observe that neutrality. With the conditions there as they are and the United States under the responsibility of suppressing insurrections, and in a country where they have insurrections once a year it makes communication a necessity." The total cost of a cable to touch at Cuba, Porto Rico, and Panama, he said, was estimated at $1,300,000. It could be laid by converting the army transport Sumner into a cable ship at nominal cost. Opposition to the proposition was made on behalf of the company now operating the American system, represented by S. C. Neale.

LEADING-IN WIRES FOR MERCURY VAPOR LAMP.—In the usual form of mercury vapor lamp the current is conducted to and from the mercury electrode by means of a platinum wire hermetically sealed through the glass wall of the evacuated chamber. On account of its coefficient of expansion, platinum is used for this purpose. It has been found, however, that such seals are subject to deterioration because of the amalgamation of the platinum wire, and, unless the platinum wire projects a considerable distance into the mercury, there is liability of heating at the surface of contact of mercury and platinum. A patent issued to Mr. W. R. Burrows on May 8 relates to means for overcoming the difficulty by forming the leading-in conductor of three parts welded together end to end. The center part is of platinum, and is completely embedded in the glass wall of the tube, and is thereby protected from amalgamation. The upper part of the leading-in conductor is of iron, and is of considerable length and cross-section to increase the area of contact between the solid conductor and the mercury electrode. The lower part, to which the terminal of the lamp is connected, is of copper.

POWER FOR THE RAND.—Advices from the Cape of Good Hope state that the plan to supply the Witwatersrand goldfields with electricity generated on the Vereeniging goldfields, near the Vaal River, is taking tangible shape, a powerful German syndicate, composed of the Allgemeine Electricitäts Gesellschaft, four German banks and Messrs. Lewis and Marks, having subscribed the necessary $10,000,000 for its realization, and two engineering experts being now in South Africa to make the final surveys. The scheme contemplates the generation of electricity in quantity by a powerful steam plant on the coalfields, which offer an inexhaustible supply of cheap fuel, and its transmission over the 35 miles which separates the Rand from Vereeniging. The plant laid down will be an extensive one, the estimates providing for $3,900,000 being spent on the power station, $1,700,000 on transformers, electric lines and sub-station, $1,500,000 on a water storage tank, and other items, $1,900,000. The output is estimated at 300,000000 units, which can be produced at a cost of ¼ d. per unit, and will yield a revenue of about $425,000 a year. The realization of this scheme will, it is said, practically shelve that of the Victoria Falls indefinitely.

COLOMBIAN CABLE CONCESSION.—United States Consul Pierre P. Demers sends from Barranquilla, Colombia, a copy of a cable concession recently granted by the Government of Colombia to Francisco J. Fernandez, a native of that country, which concession has been accepted and ratified by the Colombian legislature. The merchant of the coast must now send his messages overland on the national telegraph lines to Buenaventura on the Pacific side via Bogota, a distance of nearly 1,500 miles, or almost that from Savanilla to New York. This is not only very expensive, but extremely uncertain, and frequently involves delays of from three to five days. It is the intention of the present owner to sell his privilege or develop it with foreign capital. The French Cable Company operating in Venezuela is considering a proposition made by the grantee of the concession. The concession includes also the exclusive privilege of erecting wireless telegraph stations within the jurisdiction of Colombia. In that respect Savanilla, the seaport of Barranquilla, offers unusual advantages for the erection and successful operation of a wireless station. Stations are already established in Colon, a little over 300 miles from Barranquilla, Bocas del Toro, Port Limon, Bluefields and many other ports of the West Indies. The government guarantees, it is said, an interest of 7 per cent on practically all the capital invested.

A REPORT ON OWNERSHIP.—A very interesting and elaborate report on municipal ownership in Great Britain, made by Everett W. Burdett, a Boston lawyer, is published in the *Journal of Political Economy* for May. Mr. Burdett went abroad to make the investigation of public operation of utilities on behalf of conservative American interests. Their reports heretofore have been held as confidential. Briefly stated, Mr. Burdett's conclusions are that municipal ownership and operation of public utilities in Great Britain has been only partially successful at the best, and has failed in many of the very respects for which its supporters claim most; and that, so far as the present status in Great Britain is desirable, it is owing to the conditions which do not exist and cannot be duplicated in America. Perhaps the most serious of the ill consequences is the hampering and restriction of industry. The backwardness of the development of electrical enterprise in England led to such a state of things that in 1902 the Council of the Institution of Electrical Engineers appointed a committee to investigate conditions and suggest action that would assist the industry. The committee's tabulated conclusions showed that the United States, with less than double the population of Great Britain, has six times the amount of apparatus installed for furnishing electricity to lamps and motors, sixteen times as much for traction, twenty-three times as many miles of electric railway, twenty-six times as many motor cars, and over five times as much invested in such enterprises.

Plant of the Pike's Peak Hydro-Electric Company.

THE Pike's Peak Hydro-Electric Company has a plant located at Manitou near Colorado Springs, Colorado, which enjoys the distinction of operating with the highest head of water of any power-plant in the world, the static head being 2,417 ft. It further occupies a unique position among water-power plants in that its water wheels are operated with water belonging to a city water works. The plant utilizes a head of water which was before wasted.

The city of Colorado Springs gets its water supply from reservoirs located high up among the mountains, which are filled with the drainage from the snows on Pike's Peak. The water is taken from these mountain reservoirs along creek beds to pipe lines, which pipe lines take it down to what is called the Mesa reservoir located a short distance from Colorado Springs. This reservoir acts as a reserve storage reservoir connected directly with the Colorado Springs city pipes. The water, in falling from the pipe intakes up in the mountains to the Mesa reservoir previous to the erection of the plant under discussion, had this head entirely wasted in pipe friction. The present plant utilizes about 2,200 ft. effective head of the total fall between the mountain intakes and the reservoir, the balance being lost in pipe friction.

The Pike's Peak Hydro-Electric Company operates under a franchise granted to George W. Jackson, September 8, 1898. Under this franchise, in consideration of finishing the Strickler tunnel, which was a part of the Colorado Springs water supply system, the city of Colorado Springs granted to Mr. Jackson the right for twenty-five years to exclusive use of any water powers that could be developed in connection with the Colorado Springs water-supply system. The franchise, of course, was granted on condition that the utilization of the water power should in no way interfere with the Colorado Springs water supply. Under this franchise, right was also given to store water on the city's water reserves, thus making it possible for the company to build whatever reservoirs seemed necessary to make possible the development of a maximum amount of power without interfering with the continuity of the Colorado Springs water supply. The franchise also gave the right to string wires for any purpose on the streets of Colorado Springs. On January 1, 1903, the Pike's Peak Hydro-Electric Company formally acquired the rights under the Jackson franchise. Mr. G. A. Taff, president and general manager of the company, had secured an option of these rights six months previous to this, and had done much preliminary work investigating the possibilities of the scheme. He found that the minimum discharge through the pipe line connecting the mountain intakes with the Mesa reservoir was 486 cu. ft. per minute, and the maximum discharge 1,111 cu. ft. The storage capacity of the mountain reservoirs, when completed, he found would amount to 336,900,000 cu. ft.

FIG. 1.—BIRD'S-EYE VIEW OF POWER HOUSE AND PIPE LINE.

From the mountain intakes to Manitou a 14-in. pipe line was in existence, this pipe line being most of the way laid in a cañon occupied also by the Pike's Peak Cog Railroad. This 14-in. pipe line was not sufficiently strong for the head under which it was proposed to operate. It was therefore necessary for the company to build a new pipe line of its own, the lower end of which should be able to withstand the pressure due to a 2,400-ft. head. The plan adopted was to lay a line of light piping from a point near the mountain intakes, along high ridges, with only sufficient fall to give head enough to overcome pipe friction, and then drop to the power house through a short length of pressure pipe.

Fig. 1 gives a bird's-eye view of the power house in the valley and the surrounding mountains. The pressure pipe begins its sharp descent to the power house at the point marked *"A"* near the upper left-hand corner of the engraving. The location of this pressure pipe can be seen by the scratch down the side of the mountains, which marks the excavation for this pipe. This

pipe line is one of the most notable features in hydraulic engineering at the present day and involves work of a much heavier character than before attempted in pipe line construction.

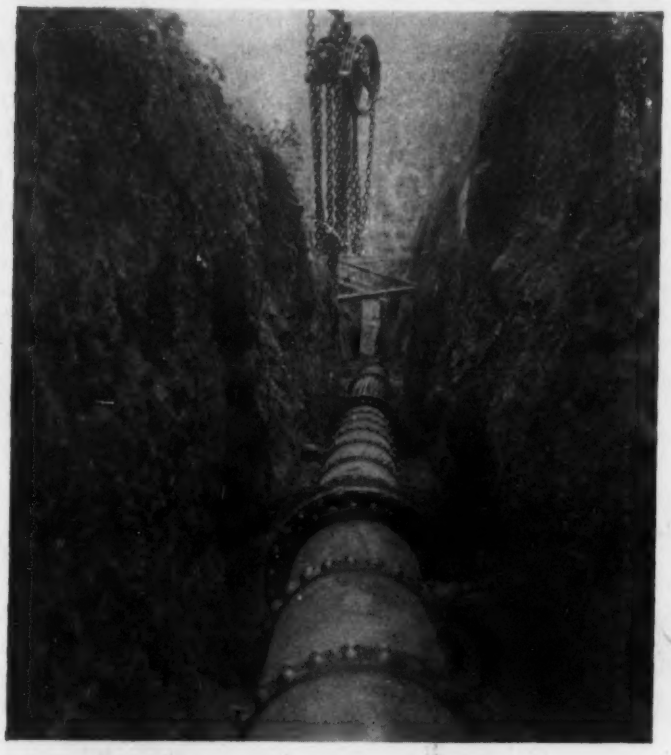


FIG. 2.—PRESSURE PIPE IN TRENCH.

The work began at once after the Pike's Peak Hydro-Electric Company purchased franchise rights on January 1, 1903, as surveys had been carried on during the six months previous. All contracts for material were let within three months, and all of these contracts called for a completion of the work November 1, 1903. The heavy pressure pipe was not completed, however, until fifteen months later. The plant began operation February 15, 1905.

The water supply at Colorado Springs, as before mentioned, comes mainly from the slopes of Pike's Peak. On account of the west slope yielding a much better supply than the east slope, the Strickler tunnel was constructed by the city in order to bring the water from reservoirs on the west slope to the east slope and thence down a creek bottom to the pipe intake. Besides the water supplied through the tunnel, there are two other creeks from which water is taken. The city intakes are at present small pools of water made by damming the creek with low dams. The company expects to enlarge these intakes considerably so as to give a small storage capacity and also form settling basins which will not fill as rapidly as the smaller basins now in existence. It will be understood that the pipe line acts as a bypass around the city's 14-in. pipe, which latter follows down the cañon from the intakes to Manitou, where the power house is located. From the intakes to the point where the pressure pipe begins, the pipe is 20 and 21 in. in diameter. The pressure pipe, which is 4,775 ft. long, is 21 in. inside on account of the extra number of rivets and the inside butt strap, which cause additional friction. Great precautions were taken to anchor this pipe thoroughly. For that reason a trench was dug and blasted for the whole length of the pipe (Fig. 2), and wherever it passed through solid rock, the trench was filled with concrete after the pipe was laid. This concrete was mixed on the spot with decomposed granite, which was found everywhere on the mountain side and which makes an ideal material for concrete, as it is sharp and cubical. There are no convex curves in the pressure pipe except near the top, so that there is no chance for the pipe to bulge out away from the mountain side. There is only one horizontal curve on the pressure pipe, and at that point there is a shoe. The pressure pipe itself is of ¾-in. sheet steel rolled into tubular form and the seam riveted to double-butt straps, one inside and one outside the pipe. The pipe was made up in 32-ft. lengths between flanges, each length being composed of 5-ft. lengths riveted to each other.

The manufacture of this pipe proved quite a problem. The contract was taken by the Holthoff Machine Company, later consolidated into the Power & Mining Machinery Company, of Milwaukee. Five-foot lengths of ¾-in. sheet steel were rolled into tubes of 21-in. inside diameter. The riveting was done on a 100-ton hydraulic press, having a special oil-tempered nickel-steel stake 18 in. in diameter, over which a length of pipe would be slipped for riveting. This stake would spring only slightly under the pressure brought against it while being riveted near its top. Of course, an enormous foundation was required for this stake. After the pipe seams and joints had been riveted, it was necessary to caulk the joints under pressure in order to be sure that they were tight. It was found that in no other way could it be determined whether the joints were tight. A factory test pressure of 2,000 lb. was applied on all the lower section of the pressure pipe. The rule on all the pipe work was to apply double the working pressure as a test. The pipe was calculated by Mr. Taff to have a factor of safety of three throughout.

From a ¾-in. thickness at the bottom, the pressure pipe gradually diminishes in thickness until the top of the steep incline is reached. One flange is counter-bored to receive the ring tunnel on the opposite flange. This counter-bored groove has a gasket of an alloy composed of one-half tin and one-half lead. This was the only kind of gasket that was found that would withstand the pressure. Pure lead was at first tried and probably would have been all right had the counter-bore been turned to fit very accurately over the ring. With the counter-bored groove

FIG. 3.—CAST STEEL HEADER.

a loose, sliding fit, as it was made in this case, it was found that the lead would be squeezed out in a thin film when the water

FIG. 4.—VIEW OF POWER HOUSE FROM ABOVE.

pressure was applied. The credit for the successful solution of the gasket problem is due to Mr. F. M. Davis, superintendent of the Holthoff factory.

The low-pressure pipe has single-riveted lap seams and also riveted lap joints. The riveting of joints was, of course, done

as the pipe was laid in this case. On this pipe there are no bends of less than 20-ft. radius.

The laying of the pipe lines was an interesting piece of work, not only on account of the extremely high pressures which part of the line had to withstand, but also because of the long, steep incline of the high-pressure pipe. To carry the pipe and the workmen up this incline, a cable tramway of 30-in. gauge was built. Alongside of this tramway was made the cut into which the pipe was laid. The cable was driven by an electric motor located at the bottom of the incline. The pipe was unloaded from a siding of the Colorado Midland Railway. It was then loaded on cable tram cars, taken up a tram road to the bottom of the incline and hoisted to whatever point it was to be laid. The low-pressure pipe was also taken to the top of the incline in this way when it was rolled off and hauled by means of one-horse wagons along the grade which had been made for the pipe.

The mountain is so steep in some places along the pressure pipe that workmen could not stand alone without something to hold to. Fig. 2 shows one of the deep cuts made for the pipe line with the block and tackle used for lowering the pipe into the cut. This view also gives a good idea of the exterior appearance of the double-butt riveted seams on this pipe.

relief valves. These are adjusted so as to open at 1,100, 1,200, 1,300 and 1,400 lbs. pressure respectively.

Although it may not be evident from the photographs, the location of the power house is such that it was necessary to make a large excavation in the side of the mountain to accommodate it. Fig. 4, which is a view taken from just above the power house, gives some idea of this, although the ground is so steep in that vicinity that it is almost impossible to secure photographs showing

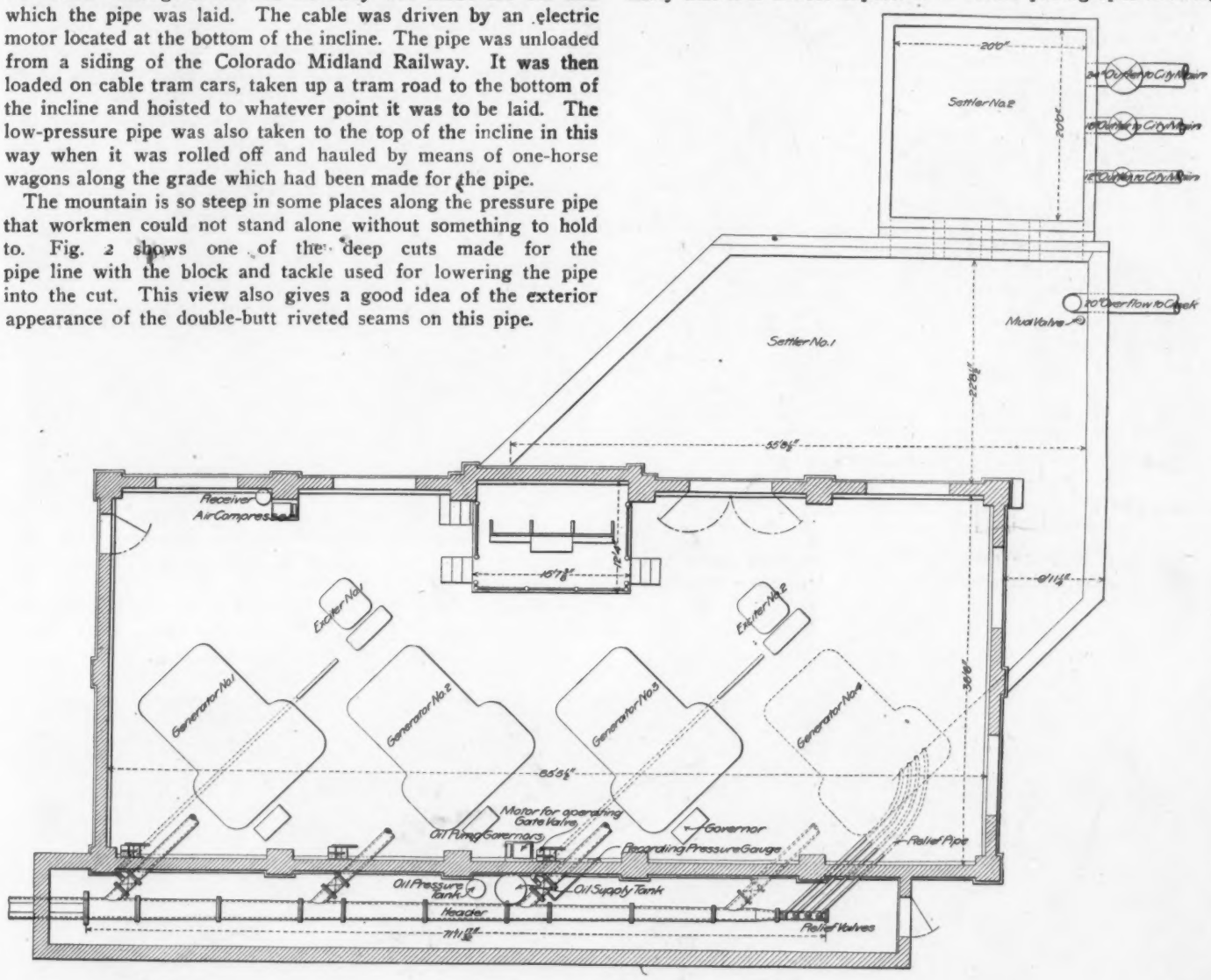


FIG. 5.—GENERAL PLAN OF POWER HOUSE.

The car on the incline railway carried 1,000 lbs. counterweight as ballast, as there are points where a change in grade causes considerable lifting on the front end of the car. The tailrope of the idler of the hoisting mechanism carried 3,000 lbs. weight. This mechanism will hoist, without slipping, a load

the true situation. There is no level ground in the vicinity. The general plan of the power house is shown in Fig. 5. Provision has been made for four generators, three of which have been installed. These generators were placed at an angle on account of greater convenience in the disposal of the waste water from

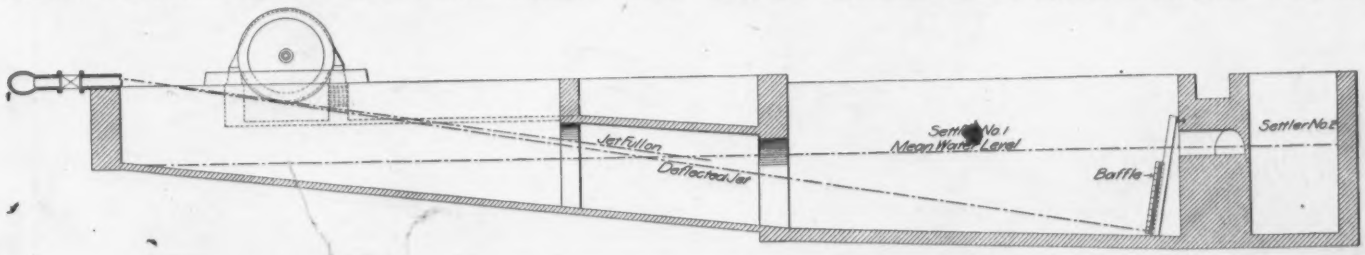


FIG. 6.—SECTION THROUGH POWER HOUSE.

of 15,000 lbs. up a 62½ per cent grade. The heaviest load ever taken up was 12,000 lbs., including the car.

At the power house, the high-pressure pipe line terminates in a header shown in Fig. 3. From this header provisions are made for four branches leading to the water wheels in the power house. At the end of this cast steel header are four Crosby 2-in.

the water wheel nozzles. As can well be imagined, the problem of successfully cushioning the force of the stream from a nozzle from which water is issuing at over 940 lbs. pressure calls for considerable skill in design. If such a stream were allowed to strike masonry or iron work, it would soon destroy whatever it impinged against. The speed of the water wheels is governed

by deflecting the nozzle away from the buckets when the load is light, thus allowing part of the water to go past the wheel with full force into the tail race. On very fluctuating load, almost the whole jet may occasionally have to be taken care of in the

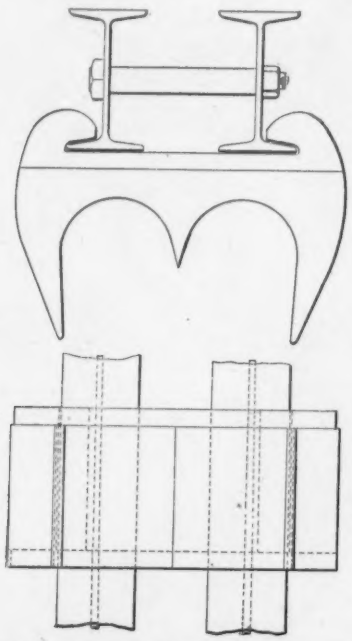


FIG. 7.—BAFFLE PLATE FOR TAIL RACE.

tail race. Fig. 6 shows a section through the power house and the settling tanks which adjoins the power house one of which really acts as a part of the tail race. It will be seen from this that when the jet is fully deflected from the water wheel, it strikes the water in the tail race at such an angle that it has about 40 ft. of water cushion before reaching the cast-iron baffles on the far side of the settling tank. Tests made to determine the effect of the unthrottled jet have shown that the jet will under no circumstances reach the baffle. It ploughs deep furrows in the water, which, when they reach a certain depth, collapse. This cycle of cutting and filling in the tail water goes on continuously. The baffle plates in the tail race, details of which are shown in Fig. 7, are made up of sections of cast iron, which slip over vertical I-beams. They are made in sections, partly on account of convenience in handling, and partly so that it will not be necessary to renew the whole baffle in case part of it is worn out. From settler No. 1 the water flows into settler No. 2 and back into the Colorado Springs water works supply from which it was taken up in the mountains.

Near the power house a small machine shop was built in the early stages of construction. This is equipped with first-class machine tools including a lathe, drill press and shaper. The structural steel for the power house was bought in standard lengths and cut and drilled here, thus effecting a considerable saving. The interior of the power house is shown in Fig. 8. It is spanned by a Whiting hand power traveling crane. Each of the three large units is driven by a Pelton water wheel running at 450 r.p.m.

Tests on the efficiencies of the water wheels made during the latter part of June, 1905, by Mr. G. A. Taff, president and manager of the Pike's Peak Hydro-Electric Company, and Mr. George M. Peek, of the Pelton Water Wheel Company, gave the following results:

Wheel on generator No. 1, 68.85 per cent efficiency.
Wheel on generator No. 2, 61.50 per cent efficiency.
Wheel on generator No. 3, 64.51 per cent efficiency.

The average for the three machines is a little less than 65 per cent efficiency at normal full load. Facilities for accurately measuring the tail water were provided a short distance below the power house. Two large wooden tanks were sunk in the side of the mountain and arranged so that one could be discharged while the other was filling, thus actually measuring the water instead of depending on a weir measurement.

The wheels are provided with Lombard water wheel governors and are governed entirely by deflecting the nozzle away from the wheel, as it would be out of the question to govern by throttling under such a high pressure. The wheels are provided with needle nozzles, by which the size of the stream can be varied by hand. It is the practice to adjust the needle valve so that the governor on one of the generators will be inactive. This generator will work along on a constant load, allowing the

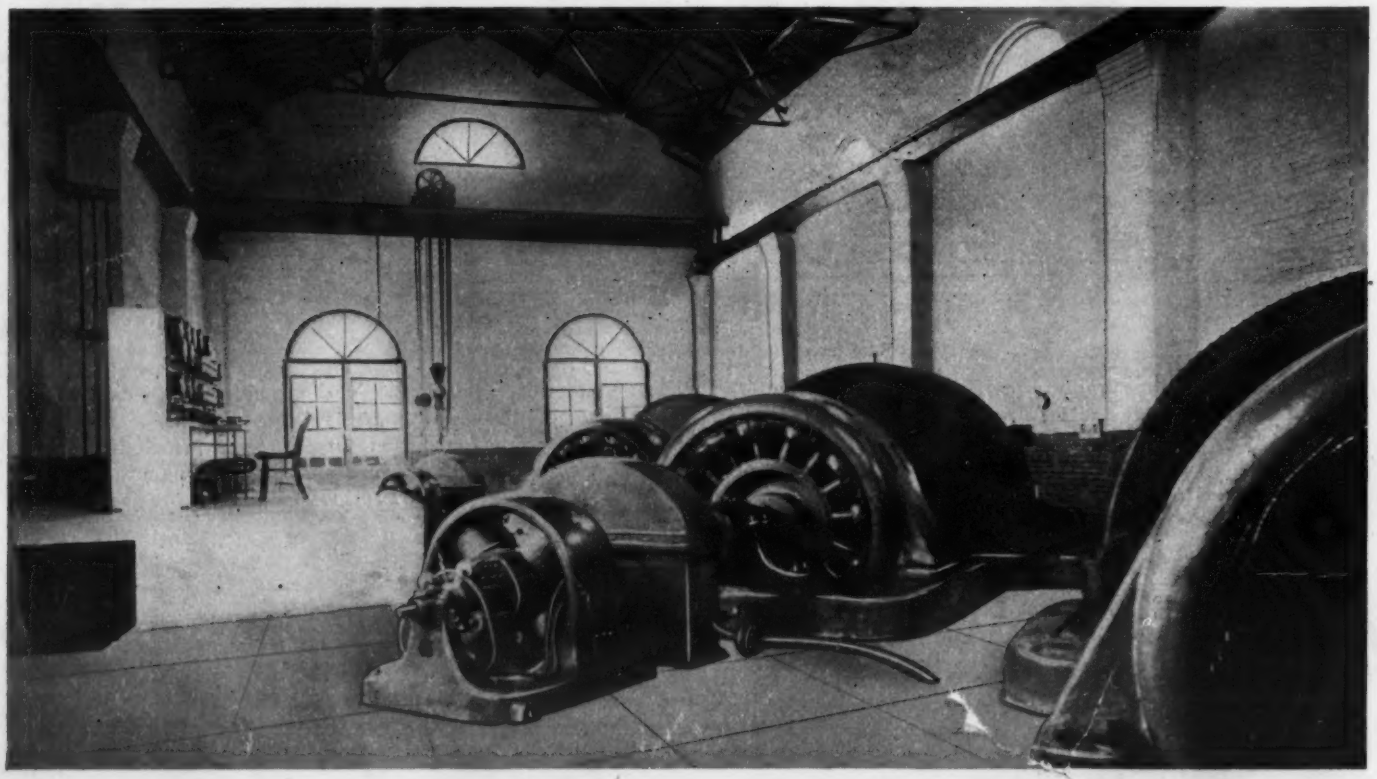


FIG. 8.—VIEW OF INTERIOR OF POWER HOUSE.

other to do the governing and take the fluctuations. This is found more satisfactory than letting both governors do the regulating. In dealing with a long, high-pressure pipe line it is of great importance to make it impossible for an excited attendant to close a valve suddenly, as such closing would wreck the pipe. The gate valve controlling the flow of water to each of these wheels is operated by an electric motor. One of these valves is shown in Fig. 9. The motor is geared by a worm to the valve

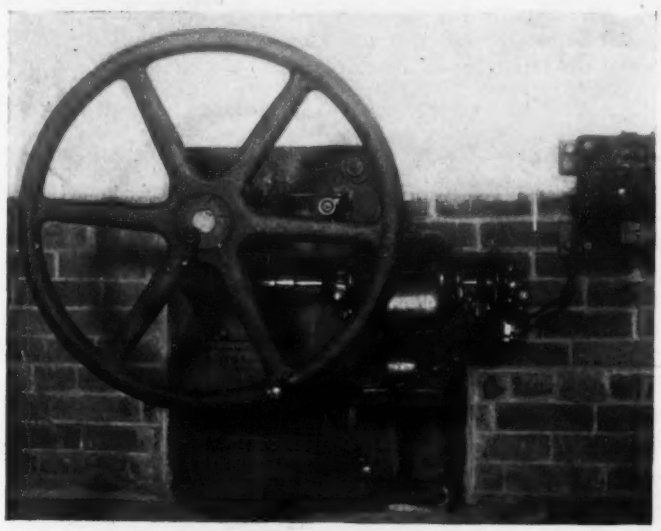


FIG. 9.—MOTOR-OPERATED GATE VALVE.

stem. The gear can be thrown in and out by means of the handle seen on the hub of the large hand wheel. This motor is operated at 125 volts direct current from the exciter circuit. When operating at full speed, it requires twenty-five minutes to close the valve when it is completely opened. The needle nozzles are also equipped with hand wheels, by which it is impossible for the attendant to close the needle valve rapidly. The pipe line is therefore well insured against shocks due to sudden stoppage of the column of water.

The three General Electric generators which are connected to these water wheels are rated at 750 kw each. They give 6,600-volt, three-phase, 60-cycle currents. They will carry full load for twenty-four hours without attaining a temperature in any part of more than 35° C. above the surrounding air, and an overload of 25 per cent for ten hours, and 50 per cent for two hours within the temperature limits. Their efficiencies are 94.5 per cent at full load, 93.5 per cent at three-quarter load, and 91 per cent at one-half load. The drop in voltage between no-load and full-load on non-inductive load, without change in field excitation, or speed, is 5 per cent. Working at rated current capacity with 80 per cent power factor, this drop in voltage between full current and no load is 20 per cent. There are two 45-kw, 125-volt exciters, direct-connected to small Doble water wheels running at 975 r.p.m. The piping for these wheels is so small, because of the high pressure, that they seem almost like toys.

The foundations, settling tanks, floors and switchboard platform, as well as the cover to the large settling tank, are all of reinforced concrete, which was mixed from the decomposed granite dug out of the side of the mountain just above the power house. A more convenient supply of material could not be imagined. A Drake concrete mixer was set up just beyond the power house site and driven by a 5-hp induction motor. Two men were employed to shovel the decomposed granite out of the mountain side into the machine and were given extra wages with the understanding that they keep it fully supplied. The mixed concrete was taken away from below by the workmen as fast as made and put into the building.

The switchboard and switching apparatus, including the oil switches, is of a design original with Mr. Taff, the oil switches with which the board is equipped being made by the company. A general view of the switchboard which is on a raised concrete platform, is shown in Figs. 8 and 10. The switches are all located under the board and are operated with compressed air by means of the small handles seen on the switchboard table. No high-tension wires come to the upper part of the board. Along the bottom of the board are disconnecting plugs, by which the oil switches can be disconnected from the high-tension circuits when the switches are to be cleaned or repaired. The cross-section through one of these oil switches is shown in Fig. 11. The compressed air cylinder and piston for operating these switches are mounted at the bottom of the switch. In fact, the same casting serves both for the switch casing and the compressed air cylinder. Compressed air for operating these switches is supplied by a storage air tank kept filled by a Christensen motor-driven compressor with motor operated off the exciter circuit. The air valves used in operating the switches are the ordinary Christensen straight air-brake motorman's valves. The only difference is in the handles, which are as indicated on the board. The upper part of the switch casing is filled with oil and has a wood fibre lining. The switches have main contacts to carry the current and auxiliary contacts upon which the arc is broken. These auxiliary contacts have an open circuit clearance of 3⅝ in. The insulating material used in these switches is kiln-dried maple wood treated by boiling in paraffine from eight to nine hours until the wood sinks and no more effervescence appears on surface of the liquid.

As the conditions were such as to make it certain that the power house would never be extended to include more than the four generators for which it is laid out, the switchboard was built with a fixed number of generator and feeder panels. The middle of the switchboard is given over to feeders, each switch handle representing one feeder. Just above the switch handle is a set of pilot lamps, one pair showing red, and the other blue, ac-

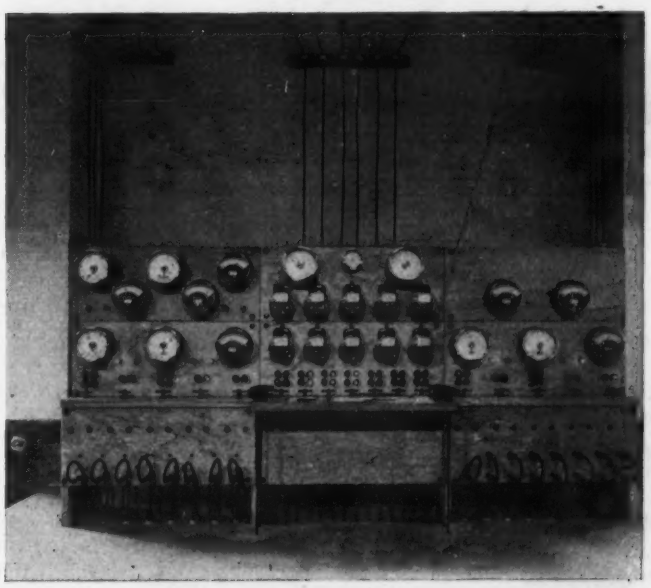


FIG. 10.—SWITCHBOARD.

cording to whether the switch is closed or open. Contacts carried on the rod which extends out at the top of the switch, complete the circuit through the red lamps when the switch is closed, and through the blue lamps when the switch is open. The generator and exciter switches are at the right and left of the board. The generator and feeder switches have double indicating pilot lamps. Next to each main generator switch is the switch controlling its field circuit. The direct-current switches are of a similar design to the high-tension alternating-current switches. Only a single pair of pilot lamps is provided for on the direct-current switch, however. At the right-hand end of each of the side panels is a switch for one exciter whereby it can be connected to the exciter bus-bars.

At present two three-phase circuits, each of solid No. 000 wire, leave the power house to feed into the transmission system of the Colorado Springs Electric Company, which buys at wholesale all of the Pike's Peak Hydro-Electric Company's electricity,

save the small amount used in lighting Manitou and the streets and public buildings of Colorado Springs. The Manitou lighting is accomplished with a 3,900-volt distribution, which is supplied by connecting the Manitou load between one of the outer wires and the neutral of the star-connected generators. This neutral is led out to the socket which appears midway between the other sockets at the right-hand lower corner of the switchboard. This, of course, unbalances the circuit, but the lighting of Manitou is a very small per cent of the total load.

The two main feeders leaving the power station run direct to a switching sub-station of the Colorado Springs Electric Company at Colorado City, where it is connected to the triangular net-

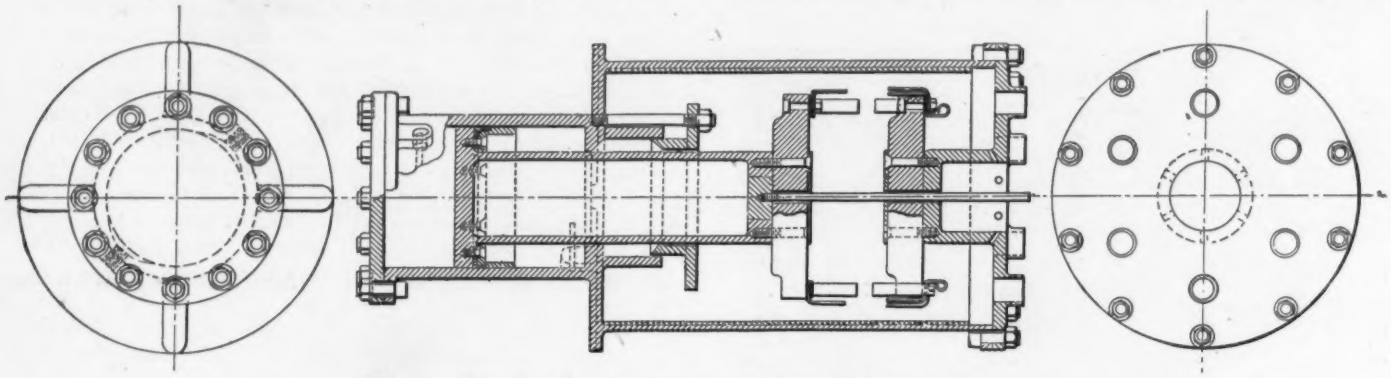


Fig. 11.—General Arrangement of Pneumatic Oil Switch.

work of 6,600-volt transmission lines belonging to the Colorado Springs Electric Company, which distributes electricity for lamps and motors in Colorado Springs and vicinity. This company's plant was fully described in this journal in the issue of June 3, 1905.

The position of the Pike's Peak Hydro-Electric Company is purely that of the manufacturer of electricity for motors, if we leave out of account the street lighting in Colorado Springs and the small distribution system in Manitou. That a very low rate must be made on this wholesale electricity is evident from the fact that the Colorado Springs Electric Company buys the electricity in preference to operating its steam plant which is located directly at the coal mines near Colorado Springs. The apparatus at the steam plant is sufficiently economical in its performance to be able to turn out a kw-hour with a consumption of from seven to eight pounds of cheap, lignite coal. The Pike's Peak Hydro-Electric plant, while an expensive one to build in some respects, is a very cheap one to operate. The regular force consists of six men to operate the power house, make small repairs, and patrol the pipe lines.

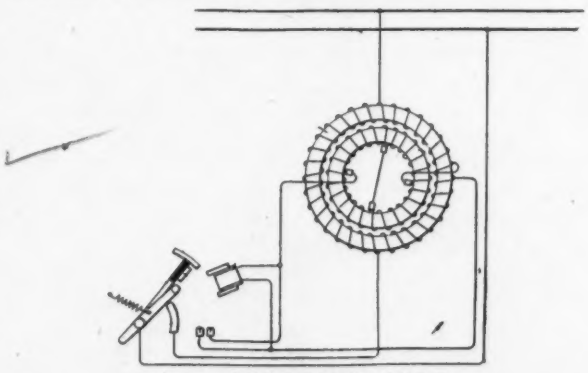
At the time the franchise under which this company operates was granted, a contract was also secured from the city to supply all the electricity needed for street lighting with 6.6-ampere, 72-volt alternating-current lamps, at a price of $66 per lamp per year, for a period of 25 years. The Pike's Peak Hydro-Electric Company has confined itself to generation, leaving the Colorado Springs Electric Company to do the work of distribution. The entire engineering of the company is in the hands of Mr. G. A. Taff, of Colorado Springs. When a market opens up for power the company will build another power station higher up in the mountains utilizing a fall of about 1,500 ft. of this same water.

Refractory Material for Electric Insulation.

Two patents issued March 27 to Mr. D. M. Steward, deal with a refractory material of high electrical resistance, which is stated to possess practically perfect homogeneity, to be absolutely fireproof and to be unaffected by cold or moisture. As the basic material, use is made of hydrous magnesium silicate, commonly known as "talc," "steatite" or "soapstone," which is mixed with a suitable proportion of water-glass sodium silicate, or potassium silicate. The effect of varying the proportionate quantity of water-glass is to change the degree of hardness obtained. For general purposes 100 parts by weight of magnesium silicate or aluminum silicate in finely commuted form are combined with 20 parts of water-glass, sodium silicate or potassium silicate in fluid form, to obtain a plastic mass having a consistency about equal to workable putty. The mixture is subjected to great pressure, which imparts to it the shape ultimately desired, and is then dried in a steam-heated kiln. The final step in the process consists in subjecting the article in the kiln-dried state to a temperature of from 1,500° to 2,000° C. for from five to eight hours. It is stated that by aid of the process outlined above minute tubes may be produced practically without limitations as to length, and that the hardness, stress-resisting qualities and the resistance to moisture and to the effects of heat and cold render the material superior for many purposes to any vitreous, or amorphous insulating substance, such as rubber or the like.

Self-Starting Single-Phase Motor.

The accompanying illustration shows a form of single-phase motor which starts from rest as a repulsion motor and automatically becomes an induction motor when a certain speed is reached, as disclosed in a patent issued to Mr. Maurice Milch



SELF-STARTING MOTOR.

on May 1, 1906. The commutator on the rotor is provided with four brushes (two-pole model). Under starting conditions two of the brushes are joined in short circuit, so that the machine starts as a repulsion motor. The other two brushes are connected in circuit with the energizing coil of an electromagnet which receives an appreciable current under the transformer e.m.f. existing between the brushes when the rotor is at rest or is revolving at a very slow speed. As the speed of the rotor increases the quadrature field produced by the repulsion motor increases also, and at a definite speed the current through the electromagnet, which is due to the difference between the transformer e.m.f. and the speed e.m.f., decreases to a value sufficient to allow the switch lever connected with its armature to be closed and the second pair of brushes to be connected together through a small portion of the primary winding. This small portion of the primary winding is included in circuit so as to impress upon the brushes a compensating e.m.f. which supplies the exciting current to the machine, and thereby improves its power factor.

Simple Circular Current Locus of the Induction Motor.

By A. S. M'ALLISTER.

IN an article which appeared in the issue of the ELECTRICAL WORLD for April 21, it was shown that by introducing certain assumptions concerning the circuits of an induction motor, which assumptions involved well-defined but practically negligible errors, the complete performance of the machine could be determined from a current locus whose most prominent feature is its simplicity. Mention was also made of the fact that it is possible to represent the various quantities necessary for ascertaining the characteristics of an induction motor graphically by means of simple circular arcs and straight lines. The present article deals specifically with the use of the simple circular locus of the primary and secondary currents of the motor for determining the complete performance of the machine.

Figs. 1 and 2, which are reproduced from the article referred to above, show, respectively, the exact representation of the circuits of an induction motor, on which a true diagram should be based, and the modified representation, in accordance with which the simple diagram is constructed. A comparison of these two illustrations will serve for ascertaining the magnitude of the errors involved in the use of the simple circular locus, a view of which is given in Fig. 3. At any point P on this locus, the line $M P$ represents the primary current, while the angle, $E M P$ is the angle of lag of the current behind the primary e.m.f., $E M$. The line $O P$ shows the secondary current, both in value and phase position. When the secondary current has zero value, that

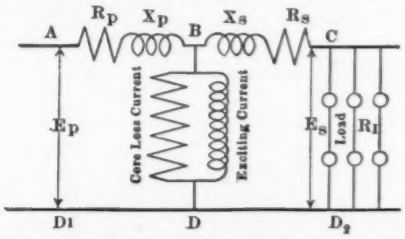


FIG. 1.—EXACT REPRESENTATION OF CIRCUITS OF AN INDUCTION MOTOR.

is, at synchronous speed, the primary current becomes equal to $M O$, $O N$ being its "wattless" component and $N M$ its power component to supply all of the no-load losses. When the rotor is stationary, the secondary current assumes some value such as $O F$, and the primary current is the vector sum of $O F$ and $O M$ (not drawn). The curve, $O P F$, is the arc of a circle having its center on the line $O N$ prolonged.

Under starting conditions, all of the power received by the

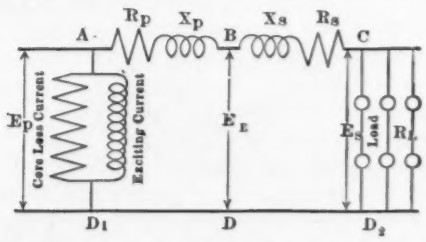


FIG. 2.—PRACTICALLY EXACT REPRESENTATION OF THE CIRCUITS OF AN INDUCTION MOTOR.

motor is used in supplying the copper and core losses of the machine. The line $F I$ is the power component of the primary current at starting, and hence, by the use of the proper scale, it may represent the total losses of the machine when the rotor is stationary. If it be assumed that the circuits of the machine are faithfully represented by Fig. 2, then the line $H F = (F I - M N)$ of Fig. 3, shows the secondary copper loss and the increase of the primary copper loss over its (synchronous) no-load value. The line $H F$ being properly divided at G, $G H$ represents the increase of the primary copper loss, and $G F$ the secondary copper loss for the current $O F$. By drawing from the point O a straight line, $O G J$, passing through the point G, the complete performance of the machine may be determined directly from inspection.

If from any point P on the circular locus a line be drawn perpendicular to the diameter, $O K$, the following quantities may be observed at once:

$M P$ is the primary current,
$E M P$ is the primary angle of lag,
$cos\ E M P$ is the power factor,
$O P$ is the secondary current,
$P T$ is the total primary input,
$T S$ is the "constant" losses of the machine,
$R S$ is the added primary copper loss,
$R T$ is the total primary losses,
$P R$ is the total secondary input, in watts;
$P R$ is the torque, in synchronous watts,
$Q R$ is the secondary copper loss,
$Q R \div P R$ is the slip, with synchronism as unity;
$Q P \div P R$ is the speed,
$Q P$ is the output,
$Q P \div P T$ is the efficiency.

The maximum power factor occurs when the point P is at A, where the line $M P$ becomes tangent to the circle.

The maximum output occurs when P is at B, the point of tangency of a line drawn parallel to $O F$.

The maximum torque occurs when P is at C, the point of tangency of a line drawn parallel to $O G$. The current which is required to give maximum torque varies somewhat with the primary resistance, but it is independent of the secondary resistance, although the speed at which the maximum torque is obtained depends largely on the value of the secondary resistance. The secondary resistance required to give maximum torque at starting bears to the assumed constant primary resistance the ratio of $G' C$ to $G' H'$ of Fig. 3.

The proof of the accuracy of the diagram in representing the value and phase positions of the primary and secondary currents for the circuits as shown in Fig. 2 was given in the article mentioned above, and it need not here be repeated. That the various other quantities are accurately represented as indicated may be shown as follows:

Denoting as α the angle $P O K$ of Fig. 3, it will be seen that $O S = O P\ cos\ \alpha$, and that $O P = O K\ cos\ \alpha$. Hence, $O S = O K\ cos^2\ \alpha$, or $O S = \overline{O P}^2 \div O K$. The interpretation of the last equation is that, as the point P moves around the circle, the line $O S$ is at all times proportional to the square of the line $O P$. That is to say, the line $O S$ is proportional to the secondary copper loss or to the increase in the primary copper loss over its no-load value. Under starting conditions, the secondary and

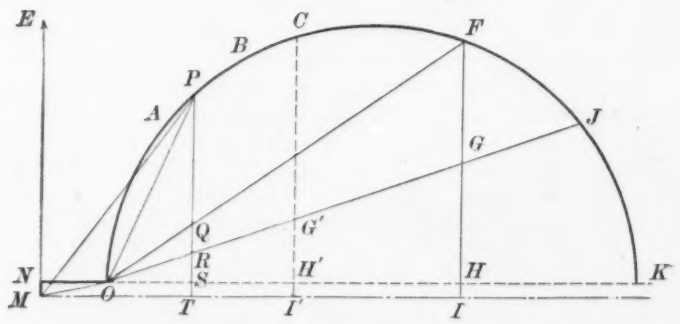


FIG. 3.—SIMPLE CIRCULAR CURRENT LOCUS OF AN INDUCTION MOTOR.

the added primary copper losses are represented by $F G$ and $G H$; and at any point P, the corresponding losses must bear to $F G$ and to $G H$ the ratio of $O S$ to $O H$. Therefore, the secondary and the added primary copper losses are accurately shown by the lines $Q R$ and $R S$, respectively.

That the ratio of the secondary copper loss to the total secondary input is equal to the slip is too well known to need proof. It seems desirable, however, in this connection to call attention to the fact that this ratio is a true measure of the slip whether the magnetism of the machine remains constant or not, and that the accuracy of the determination of the slip by this method is in no wise affected by the substitution of the modified circuits of Fig. 2, for the exact circuits of Fig. 1. Thus, if the secondary

copper loss is determined without error, and the secondary input is known, both the speed and the torque may be ascertained with precision. It is seen, therefore, that any errors introduced must relate to either the currents or the losses.

If the points O and F of Fig. 3 are obtained from an actual test on a machine, it is evident that the circle diagram as constructed must be at least approximately correct for the primary current locus. Under starting conditions the power received by the machine is accurately represented by the line $F I$. If the distance $F G$ be drawn equal to the easily determined "added" primary copper loss, the distance $G H$ must represent the secondary copper loss with a fair degree of accuracy.

It is especially worthy of note that under starting conditions and at synchronous speed the errors are eliminated, and throughout the operating range of the motor the various errors tend to cancel each other. Even in extreme cases, where the (synchronous) no-load triangle, $O M N$, is large in comparison with the circle diagram, the errors are relatively small and for most practical purposes may well be neglected.

It is not possible to obtain absolute accuracy in a simple diagram of an induction motor. Moreover, it is unnecessary to construct a diagram with a degree of accuracy greater than that which can be employed with it in scaling off the various values. The principal advantage to be found in the graphical method of treating induction motor phenomena resides in the fact that by the use of a simple diagram one is able to follow optically, and thus mentally, the changes which take place throughout the operation of the machine, while in the manipulation of algebraic formulas, which can be used for absolute accuracy, one is apt to find himself more or less in the dark concerning these changes.

Synchronous Converters Versus Motor Generators.

By Clarence P. Fowler.

ALTHOUGH synchronous converters have in the past been largely employed as the connecting link between alternating current and direct current networks, yet doubt seems

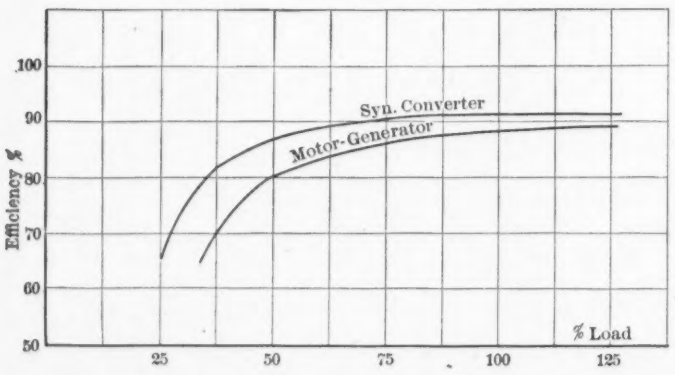


FIG. I.—EFFICIENCY CURVES OF 60-CYCLE MACHINES.

to exist in the minds of some engineers as to whether or not this class of apparatus is as suitable (under some conditions) for the conversion of current as the motor-generator—a double machine unit, consisting of an alternating-current motor direct connected to a direct-current generator—the two machines being mounted on a common bed plate.

In what follows, it has been endeavored to institute a comparison between these two well-known types of dynamo electric machinery, covering the following characteristics in the order named: 1, efficiency; 2, floor space and cost; 3, inherent regulation and voltage control; 4, overload capacity; 5, methods of starting; 6, hunting; 7, power factor; 8, frequency; 9, reversibility.

In order that comparison may be made on what seems to be a common plane, the induction motor-generator set will be excluded from consideration, and the motor used will be assumed to be of the synchronous type. This machine, like the synchronous converter, has the advantage of phase control by variation of field excitation, and this generally tends to improve the power factor of the system to which it may be connected.

The synchronous motor armature will be assumed to be wound for the direct application of the working voltage of the system, namely 6,600 volts, and will therefore be of the revolving-field type.

Efficiency.—In comparing the efficiencies, combined efficiencies will be considered. These will depend upon the total losses of conversion from high-tension alternating current to direct current, which would include the losses in transformers plus losses in converter in one case and total losses in the motor and the generator in the other. Under these conditions the synchronous converter shows quite a percentage gain in efficiency at full load over the motor-generator, the efficiency in favor of the converter becoming more marked at lighter loads, due to the relatively lower copper and iron losses of the latter machine. It might be noted here that this better efficiency on the part of the rotary converter at fractional loads has quite a marked

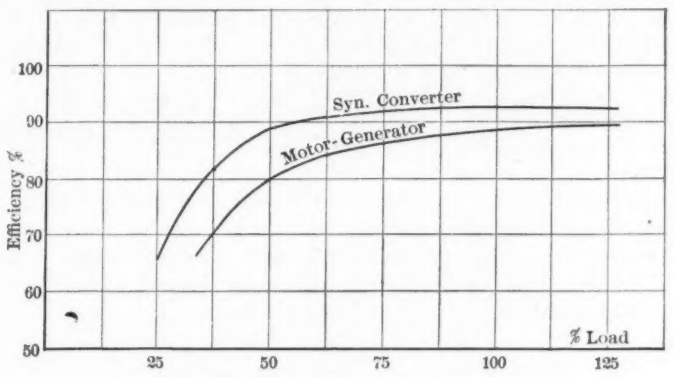


FIG. 2.—EFFICIENCY CURVES OF 25-CYCLE MACHINES.

effect in improving the "all day" efficiency of the plant using this type of machine.

This poor showing in efficiency is one of the most serious drawbacks that the motor-generator possesses, and has been a great barrier to its adoption in substations fed from steam-driven stations where fuel forms a large portion of the operating expenses. The comparative efficiencies are clearly demonstrated by references to Figs. 1 and 2—Fig. 1 showing the combined efficiency curves for a 500-kw, 575-volt, 60-cycle synchronous converter and the equivalent motor-generator, and Fig. 2 giving a similar set of curves for a 500-kw, 575-volt, 25-cycle synchronous converter and the corresponding motor-generator set.

It is notable in comparing the curves of Fig. 1 with those of Fig. 2, that in the case of the converter designed for the lower frequency the efficiency is somewhat higher than that of the 60-cycle machine, while the motor-generators for the two frequencies are practically equally efficient.

Floor Space and Cost.—Again taking the two machines of Figs. 1 and 2 as a basis for comparison, the cost per kilowatt of the 500-kw, 60-cycle, 575-volt converter and lowering transformers would be $15.50, while that of the motor-generator for the same output, frequency and direct voltage would be $19. For 25 cycles the relative costs would be $16 for rotary and lowering transformers, while for motor-generator the cost would be $20. These facts serve to show not only the relatively higher cost of motor-generators—being a double unit instead of one—but also the greater inherent output which the converter possesses per pound of active material as will be discussed later under full load conditions on the direct-current side of the machine.

As regards the floor space occupied, the motor-generator has the advantage over the synchronous converter with its lowering transformers, although this objection vanishes and actually turns in favor of the rotary if the transformers be mounted on a superstructure such as a gallery, as is found in some of the more modern installations. Assuming, however, that the lowering transformers for the converter are placed on the

floor, the relative number of kilowatts capacity per square foot of floor space in the case of the two sets of 500-kw outfits before considered would be as follows: For 60-cycle converter, 4 kw per square foot floor space; for 60-cycle motor-generator, 5.62 kw per square foot floor space; for 25-cycle converter, 4.35 kw per square foot floor space; for 25-cycle motor-generator, 5.55 kw per square foot floor space.

Inherent Regulation and Voltage Control.—With the synchronous converter, any voltage disturbances which occur on the alternating-current system are obviously reproduced on the direct-current side, which could not occur with the motor-generator set provided the impressed alternating voltage does not drop to the point at which the motor falls out of step, and, it might be added, that some engineers' specifications are now calling for synchronous motors which shall not fall out of step when the impressed voltage falls as much as 15 per cent under full load conditions on the direct-current side of the machine.

For railway service where voltage regulation is not as exacting as with lighting, it is usual with converters to depend upon automatic compounding by the aid of a series field winding in conjunction with a judicial amount of reactance* inserted between the rotary and its source of supply.

With the closer regulation necessary in the operation of rotaries for lighting purposes, it is usual to have some device such as the induction regulator, which can be controlled by hand and which permits of variations of the applied alternating voltage over a wide range in a gradual manner.

With the motor-generator, however, the direct voltage bears no fixed ratio to the alternating voltage, and the former can, therefore, be gradually varied over a wide range by simple shunt field control of the direct-current generator. This method of control presents considerable advantages in simplicity over the one just cited for synchronous converters.

Overload Capacity.—Owing to the neutralizing effect of the alternating and direct currents in the converter armatures, there results a low copper loss for this type of machine, and, since the heating is reduced, the output may be increased as compared with the same armature forming part of a straight direct-current generator. This low copper loss on the part of the converter becomes more marked as the number of the phases increases, as might be expected, owing to the greater distribution of the leading in taps on the alternating-current side of the armature, as well as to the increase of the average length of time when an alternating-current tap to armature winding will have the same angular position as the brushes resting on the commutator, thereby reducing the effective length of the path through which current must flow before finding an outlet on the direct-current side.

TABLE I.

RELATIVE ARMATURE HEATINGS FOR SAME LOAD.

	D. C. Gen.	Three-phase Converter	Two-phase Converter	Six-phase Converter
(H)	1.00	.555	.37	.26

Table I gives the relative heating of the same armature used as an ordinary direct-current generator, and also when the same machine is used respectively as two, three and six-phase converters at unit power factor, the heating of the direct-current generator being taken as unity.

TABLE II.

RELATIVE RATINGS FOR SAME HEATING.

D. C. Gen.	Three-phase Converter	Two-phase Converter	Six-phase Converter
1.00	1.34	1.64	1.96

The heating being proportional to the square of the current and as the output is proportional directly to the current, for the same heating the relative rating by armature heating can be obtained by multiplying the rating of the direct-current generator by $\frac{1}{\sqrt{H}}$ from which is derived Table II in which the rating of the direct-current generator is taken again as unity.

It is seen, therefore, that for a given amount of copper and iron the converter is quite superior in output to the generator and especially to the motor-generator.

Further, the amount of load that may be carried by the converter is not dependent upon the mechanical torque, as there is no transference of mechanical power from the alternating current to the direct current side as would be the case with the motor-generator set, the maximum load on the former type of machine being limited by the heating of the armature conductors.

Methods of Starting.—The synchronous converter and the motor generator set are about on a par as far as starting characteristics go, neither being self-starting without considerable disturbance to the system, and in order that they may be started, each requires some form of auxiliary starting device such as a motor, or provision must be made for starting from the direct-current end which requires some initial source of direct current when the sub-station is to be started up after having been completely shut down.

Hunting.—The tendency on the part of the rotating members of synchronous apparatus to alternately speed up and slow down is found to some extent in both synchronous converters and motor-generators. Inasmuch as this phenomenon is accompanied by the shifting of the magnetic lines of force across the polar arc, anti-hunting devices in the shape of heavy copper grids (surrounding and embedded in the pole face) have been quite effectively applied in the case of the synchronous converters without undue eddy current losses in these damping devices.

With synchronous motors wound for the direct reception of high voltages, which consequently have a fewer number of slots, the employment of such expedients for the prevention of hunting becomes more or less prohibitive owing to the excessive eddy current losses in the damping devices. The tendency toward hunting increases with the frequency, the higher-frequency converters being more sensitive in this respect than motor-generators, owing to the fact that high-frequency converters cannot be satisfactorily designed with sufficient armature reaction to produce the desired stability.

Power Factor.—The synchronous converter has no appreciable torque upon its shaft, and with constant field strength, the power factor is practically independent of the load on the direct-current end. This is a condition that prevails with converters used for lighting service which are usually shunt wound, and is clearly exemplified by a test on some converters of which the writer had charge, the results of which are given below. The machines upon which the tests were made are ordinarily used for serving a large urban railway system and were of 1,500 kw capacity, 3-phase, 25-cycle, 600 direct volts, the machines were equipped with series field coils, but these were never used, even in regular service, to obviate the possibility of a runaway upon the reversal at the direct-current end.

The readings which were taken when the field current was held constant and the load varied on the direct-current end are as follows:

Direct Current Load, Kilowatts.	Direct Current, Field Amperes.	Alternating- Current Power Factor.
0	8.5	99
375	8.5	99
630	8.5	99
935	8.5	99
1240	8.5	99
1420	8.5	99
1520	8.5	99

The above readings correspond approximately with similar observations made upon another unit which was designed as an exact duplicate of the first.

As before stated, it is usual in railway practice with converters to use series coils with reactance inserted in the alternating-current leads. When the amount of the reactance is properly chosen, and care is exercised in adjusting the current in the series field coils by the use of a shunt resistance, the power factor may be held quite high over a wide range of loading at constant potential. Thus it is possible to obtain the results shown by the curves of Fig. 3, which give the relation between the power factor and the load with the same reactance

* See writer's paper on "External Reactance for Synchronous Converters," ELECTRICAL WORLD AND ENGINEER, June 17, 1905.

inserted, but the series field coils in curve *A* are shunted to give 100 per cent. power factor at full load, whereas with curve *B* the series field coils are shunted to give 100 per cent. at three-quarter load. Keeping the power factor constantly high at partial load as in curve *B* means decreased heating of converter at light load and is an important factor where loads are fluctuating as in railway service.

In the case of the synchronous motor-generator set the state of affairs is different because of the mechanical transference of power from the motor side to the generator side. This is the well-known case of the simple synchronous motor working against a resisting torque, and under such conditions there is a critical load for each field strength which brings the current into phase with the impressed e. m. f. so that for stability of power factor under varying loads on the direct-current generator, it would mean considerable adjustment of the motor field to eliminate the wattless component of the current at all times.

Furthermore, if the synchronous motor is excited from the direct-current generator which it drives (which is usually the

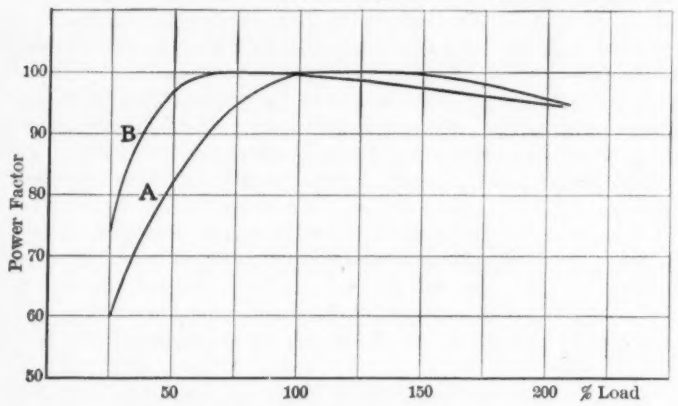


FIG. 3.—EFFECT ON POWER FACTOR OF ADJUSTMENT OF SERIES FIELD CIRCUIT OF SYNCHRONOUS CONVERTER.

case) and if this latter machine is over compounded, then under fluctuating loads, an added complication will exist of varying the field on the motor, which will have the effect of producing a rather unstable power factor.

Frequency.—With the motor-generator set composed, as it is, of two machines electrically independent of each other, each may be designed for its intended purpose, the only condition common to both being the speed, and this is determined by the number of the motor poles, which is not, however, hampered by any consideration of the direct-current generator to which it is conected, and the motor may be designed for operation without any difficulty on circuits of frequencies now largely in commercial use, namely, 25 cycles and 60 cycles per second.

As regards the converter, however, quite different conditions exist, since the electrical independence of the alternating current and direct current sides is lost and the best design naturally resolves itself into a compromise of the features of the component types. At the lower frequency, 25 cycles per second, the converter shows an excellent performance, and it is at this frequency that all the modern large systems, employing converters, are operated.

There are, however, certain lesser systems with which it is considered advisable to combine a lighting and railway load, operating at a frequency suitable for lighting. It is on such systems that the high frequency converter has its widest field of application.

The aggregate output of railway converters designed to operate on 60 cycles per second is now quite large although manufacturers formerly hesitated to build them. Generally speaking, their behavior is rather unsatisfactory for the following reasons:

They have a tendency to hunt, owing to the limited distance between poles, which renders it difficult to design a machine, having high armature reaction, which property is conducive to stability of operation.

Direct-current generators as ordinarily constructed do not commutate well, when operating at speeds which produce frequencies higher than 25 cycles per second, owing to the large number of current reversals per second, and the attendant difficulties in commutating.

With the high commutator speed necessary with 60-cycle converters there is found to be considerable difficulty in keeping the brushes in intimate contact with the commutator surface—resulting in the necessity for increased brush tension with the somewhat abnormal resultant wear of both the brushes and the commutator.

Due to the relatively short commutator arc between positive and negative brush holders, the arc of commutation is very limited, so that the machine becomes very sensitive to slight changes in the position of the neutral point, and frequently this condition becomes so aggravated as to cause the machine "to flash over," as might result from the shifting of the magnetic lines of force across the polar arc as a result of hunting troubles.

With the crowded brush holders it becomes much more difficult to replace brushes under operating conditions (should this be found necessary) than would be the case were more space available such as is the case with the low-frequency type of converters.

Several improvements in details of design have been applied to 60-cycle, 575-volt converters to alleviate some of the above troubles, with varying degrees of success, such as specially designed brush holders with moving parts of small inertia, which will readily accommodate the brush surface to the swiftly moving commutator.

Also with multiple wound armatures a large number of balancing rings have been found necessary to equalize the potential generated in the individual armature circuits.

These and other artifices have been used to render the 60-cycle, 575-volt converter operative, but the same is inherently faulty, and no amount of finesse in design can render its performance equal to that of a 25-cycle machine, constructed for the same voltage.

Reversibility.—Although synchronous converters, primarily designed to convert alternating current to direct current, are not best suited to operate as "inverted converters," or for converting direct current to alternating current, owing to their relatively high armature reaction, yet they may be sometimes called upon to temporarily handle this class of service, and when so operating the speed of the machine as a direct-current motor is no longer fixed by the frequency of the supply circuit, but depends upon the field strength.

When supplying alternating current of low power factor the field may become so demagnetized as to cause the armature to reach a destructive speed if it is not equipped with a speed-limiting device. A separate direct-connected exciter with under-saturated field, whose voltage is very sensitive to changes of speed, may be employed for maintaining the speed at its normal value.

With the motor-generator set, which has two separate fields, obviously any reactions on the alternating end do not in any way affect the strength of field on the direct-current end. It is due to this fact that when converting from direct current to alternating current the motor-generator speed is considerably more stable than that of the converter.

Summing up the situation, it would seem that each type of converting apparatus has a field of its own where it can be most advantageously employed.

From what has been set forth above it is apparent that, all things considered, the converter is decidedly advantageous for use in an urban system for supplying power to lamps and motors from a large central station at a moderate frequency, the motor generator showing its superiority when operating from a system having a relatively poor regulation, as in the case of lighting circuits from a long transmission line, and also for furnishing a desirable method of obtaining a direct current for railway service from 60-cycle systems.

Rubber Insulated Cables Without Lead.

BY JAMES S. MCLEAN.

In one of the papers on rubber-insulated underground cable, read before the American Institute of Electrical Engineers, extracts of which were published in the ELECTRICAL WORLD of May 5, 1906, the writer notes that the suggestion was made that the proper cure for electrolysis is to omit the lead sheath. This would be true under certain conditions, but in the writer's opinion these conditions do not obtain in any present conduit system where there are ever present acids and gases of various kinds that have a deteriorating effect upon rubber insulation.

This brings up the question of a suitable substitute for lead. The principal requirements of such a compound are that it should have a neutral reaction, should be acid, alkali, and moisture-proof, should be a non-conductor, should have great flexibility under temperatures ranging from —18° C. to at least 65° C., and should be of such mechanical strength as to withstand all mechanical injury during installation. It is to be regretted that a material with the above qualifications has not yet been discovered.

In this connection the result of the writer's observations on an installation of non-leaded rubber-insulated cable on which his opinion had been asked might be or interest.

In this particular system, which was a 220-volt direct-current commercial one, the main cables were leaded and the tap or service cables were without lead and comparatively short, run through glazed clay conduits. The cables themselves were regular 600-volt white core rubber, finished with two cotton braids saturated with a weather-proofing compound. The insulating compound probably contained 15 per cent to 20 per cent of pure Para rubber mixed with zinc white or Paris white, or both, and various other mineral ingredients.

The manholes were small and comparatively dry, and the cables were stretched straight across the center, the splices being made by clamping the bared ends of the conductor into brass lugs which were left uninsulated. This, of course, was extremely bad engineering.

The trouble which developed on these unleaded cables after a few months of service was as follows: A white crystalline deposit formed upon the cable at the edge of the duct; soon after the deposit appeared the rubber insulation began to swell until it was separated from the conductor and was several times its original dimensions. This swelling, of course, broke through the cotton braiding, and longitudinal cracks appeared in the insulation, which lost its original black color and took on a flesh color, the exposed surface being covered with clots of a glistening yellowish-white substance. Altogether the cracks had the appearance of ulcerating flesh wounds. The surfaces being moist, were fairly good conductors and so grounded the cables.

Upon submitting the white crystalline deposit to a chemical analysis it was found to contain a large percentage of free sodium and some common salt, as well as dirt and other impurities one would necessarily expect. This was perfectly natural under the conditions.

As is generally known, clay conduits are glazed by sprinkling the interior with an excess of common salt while hot. Now when these ducts are laid and condensation is formed in the ducts, some of the excess salt passed into the solution which eventually collected upon the cable at the edge of the ducts.

With the above conditions there was a leakage current which passed through the solution, and by electrolytic action the sodium chloride was separated into sodium and chlorine, the sodium forming a deposit, and the chlorine dissolving in the water. At the same time that this action is going on, some of the water is broken up into hydrogen and oxygen. The free hydrogen and chlorine will not unite by being mixed in the dark, but needs diffused sunlight to form combination. As these two gases are formed in the dark they will in all probability simply remain a mechanical mixture in water, but to all intents and purposes as far as chemical reactions go, they form hydrochloric acid. This attacks the weather proofing compound and eventually the acid chlorine gas reaches the insulating compound, where it preceded the presence of hydrogen, to attack the zinc oxide in the compound, forming zinc chloride and water. As soon as the zinc chloride had been formed it in turn atacked the rubber in the insulating compound with a rapidly deteriorating chemical action. The chemical equation of such action is as yet merely a conjecture by such men as Carl Otto Weber, Ph.D.

While the above action is going on the free sodium attacks the rubber, by softening the surfaces, after which the rubber rapidly decays. The above combined actions soon destroy the insulation.

In the writer's opinion the above are the principal chemical and electrical actions which destroyed the insulation in this particular case. What other actions take place in this or any other conduit system at any time can only be conjectured.

The above instance is, of course, an extreme case, but is an indication as to what unprotected rubber insulation in a conduit system is exposed to. Even if the insulation had been continuous, the possibility of the above action would be an ever-present one, as leakage currents would at some time traverse the duct system and the cables therein. This, as well as the deteriorating action on the rubber by the gases in the duct system, would of necessity shorten the life of the cable.

Electrolysis is, of course, a bad thing, but with a reasonable amount of care the life of a cable system can be greatly lengthened. The majority of operating companies seem to fail to realize the importance of systematic tests, and the change of bonds to meet the requirements of these tests, the general practice seeming to be that of having the cable manufacturer bond the cables, and let it go at that, making no tests or changes in the bonding until the cable begins to show trouble; then the cable manufacturer is notified and his experts make tests to locate the trouble, and submit their reports. In almost every case the operating company is at fault, all due to the fact that it does not realize the importance of giving the cable system the benefit of expert care.

It seems, therefore, that until the discovery of a cheap compound which is acid, alkali and moisture-proof, of great flexibility and mechanical strength, as well as a non-conductor, as a substitute for lead sheath, we must pay attention to the bonding of the cable and try to impress upon the operating companies the necessity of giving the cable system the benefit of expert care. In the writer's opinion this will remedy a large number of complaints of trouble caused by electrolysis. Of course it will not entirely remedy it as long as lead sheath is used, so we must try and control the conditions as far as possible until such time as a substitute has been discovered.

New Telephone Patents.

SUB-STATION CIRCUIT.

For common battery systems there has been a gradual evolution of the subscriber's instrument circuit. At first it was considered sufficient to use a low-resistance receiver included directly in series with the transmitter and line. The necessary low resistance of the receiver and the inclusion of the receiver cords

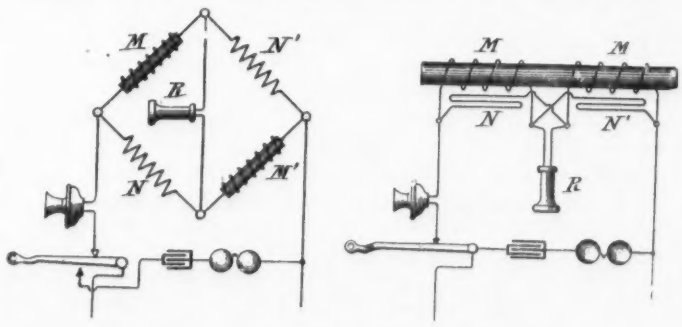


FIG. I.—MANSON TELEPHONE SYSTEM.

in the battery circuit proved serious defects and an induction coil primary was then substituted for the receiver, which latter was connected to the secondary. From this there have been various deviations, using both induction and reactive coils in various combination with condensers. As an improvement over all these,

R. D. Manson has brought out a bridge arrangement of receiving circuit shown in Fig. 1. In this the coils *M*, *M'*, *N* and *N'* are all of equal ohmic resistance, and thus for direct currents there is an equal drop of potential in each part, and there is no direct current flowing in the receiver. For alternating telephone current there is an entirely different effect, for two of the coils are wound inductively and two non-inductively. The inductance of the two reactance coils is of so great effect as to render their impedance to the telephone practically infinite, so that all telephone current must go through the receiver. Mr. Manson has patented his invention and has assigned his patent to the Dean Electric Company.

STATION APPLIANCES.

A. V. R. Fechtenburg, of New York City, has patented an auxiliary receiver support for use when one has temporarily left the instrument. This support is in the form of the usual hook, and is to be mounted in a convenient position. The hook lever is pivoted, the weight of the receiver overcoming the normal upward tension of a spring. A toothed sector is opposed to a wiper attached to the hook, and thus as the hook descends or ascends as the case may be, a series of momentary contacts occurs between these parts. By suitably arranging the wiring these contacts are made to shunt the transmitter to cause a clicking signal to notify the waiting party at the other end of the connection of both the departure and approach of his correspondent. It is unlikely that telephone companies will hail this invention with satisfaction, as the only way to induce subscribers not to leave a telephone off the hook, is by making it impossible to leave a receiver in circuit without its abnormal position being very noticeable.

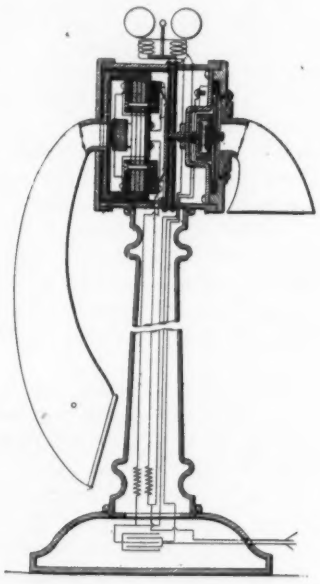


FIG. 2.—LEVENBERG TELEPHONE.

Fig. 2 shows an attempt to improve the desk stand set by a complete change in its various parts. Both receiver and transmitter are in cylindrical cases with rotating mouthpieces. The receiver part carries trailers traveling over a commutator to effect the circuit changes. This set is the invention of S. P. Levenberg, of New York,

C. E. Egan, of Columbus, O., has obtained a patent for a polarized bell, combined with a condenser. The bell has the usual frame and two-legged magnet; one leg, however, is provided with a coil, the other carrying a cylindrical rolled type condenser of similar appearance. Mr. Egan has assigned his patent to the Egan Electric and Telephone Manufacturing Company.

A revolving adjustable desk arm has been patented by T. J. Skelley, of Collinwood, Ohio, which is built upon a somewhat different plan from the usual one. The arm is composed of three rigid bars pivoted upon vertical pins and arranged to swing over each other in horizontal planes. The telephone set, arranged as for a desk set, is secured to a vertical pivot on the end of the outermost bar.

PARTY LINE.

L. A. Schmidt, of Chicago, has invented a party-line system with a lock-out feature. Each station has two double-wound relays, the contacts of one opening the line beyond its own station, and those of the other opening its own station circuit. The middle of each relay winding is connected to one of its contact joints. Current drawn through the relay and contact is differential in effect on one relay, and cumulative on the other, and vice versa. By this means a station having right of way holds its own circuit, cuts off the line beyond and cuts off the telephones of stations between it and the exchange.

SWITCHBOARDS.

A switchboard providing for a plug ejecting jack has been patented by S. Kitsee, of Philadelphia. It is doubtful, however, if there is anything of practical value in the invention.

Mr. E. Land has invented a semi-automatic switchboard, in which the operator receives all signals automatically, even the number desired, and then in response completes the connection. In this instance she manipulates keys to do this, but the complexity of her duties is much too great.

A patent, assigned to the Kellogg Company has been granted to W. W. Dean for an improved circuit for one-way trunks for use with certain two-wire switchboards. The present improvement provides a guard signal.

LETTERS TO THE EDITORS.

Life of Incandescent Lamps in Frosted Globes.

To the Editors of Electrical World:

SIRS:—Referring to the article by Messrs. Cravath and Lansingh in your issue of March 17, 1906, page 917, on the effects of frosting incandescent lamps, the results apparently show considerable superiority in point of life for lamps in enclosing globes as compared to frosted lamps.

If, however, the loss of light due to enclosing globes is taken into consideration, and the lamps be brought to the same mean spherical watts per candle (read through the globe) as the frosted lamps in the same report, the lamps enclosed in globes would give but 53½ per cent of the life values shown for these lamps. That is, the life of lamps in enclosed globes would be only 226 hours, which is about the same life the frosted lamps give according to the tests described.

It seems to me in justice to frosted lamps that this point of view should be taken into consideration. Frosting a lamp reduces the light but a small percentage—6 to 8 per cent—where the use of a frosted enclosing globe reduces the light from 20 to 25 per cent.

HARRISON, N. J. F. W. WILLCOX.

Rolling Mill Electric Motors.

To the Editors of Electrical World:

SIRS:—Referring to the interesting article on "Motors in Rolling Mills" in your issue of April 21 it may interest your readers to learn of the development of electrically-driven rolling mills which has taken place in Sweden. As early as 1894 the Boxholm iron works installed two three-phase induction motors of 100 and 70 hp respectively, furnished by the Allmanna Svenska Elektriska Aktiebolaget, of Vesteras, which firm has been the leading one in Northern Europe in the alternating-current branch of electrical engineering. Shortly thereafter the Hofors iron works installed 750 hp in motors for driving some of its rolling mills. In the last 10 years a great many other iron works have adopted the electrical system to a smaller or larger extent, such as Domnarfvet (600 hp, a large number of smaller motors not included); Horndal (750 hp); Nordiska Metallaktiebolaget (about 1,100 hp); Fagersta (2,200 hp); Sandviken (2,700 hp).

The system used in Sweden almost without exception for driving rolling mills is the three-phase. There are several reasons for adopting this system, one of the most important being the simplicity in construction and service of the three-phase induction motor, which is least likely to be damaged from the presence of iron or coal dust. An objection to the use of induction motors is the difficulty of economical speed variation. The Allmanna Svenska Elektriska Aktiebogalet has, however, by using certain inventions of Lindstrom and Danielson, solved this problem in a satisfactory manner. The motors are built either with windings that can be connected for either of two sets of poles, the one being the double of the other, or are built as concatenated (tandem) motors, thus running either at a speed corresponding to the number of poles of the primary motor or at a speed corresponding to the total number of poles of the primary and secondary motors. Motors have also been built with a combination of these two methods such that either the primary or the secondary of the concatenated motors is provided with a two-speed winding. Some motors of this type are used at Sandviken, one of them consisting of a primary motor with 32 or 64 poles and a secondary motor with 4 poles. The secondary motor is used only in connection with the 32-pole winding of the primary motor, and the machine will thus run at 182, 165 or 91 r.p.m., with a normal output of 600, 535 or 300 hp, respectively. Another motor of the concatenated type, but with a two-speed secondary motor winding, runs at 428, 375, or 333 r.p.m.

At the Fagersta iron works there are 7 motors for driving the rolling mills, one of which is a 400-hp tandem motor, with a speed of 180 and 120 r.p.m. Of special interest are the arrangements for driving the large blooming mill at these works. The main motor is a 600-hp, three-phase induction motor running at 214 r.p.m. The power is transmitted by ropes from the motor to a large grooved pulley built as a heavy fly-wheel (70 tons) and connected to a Lindsay coupling for reversing the rolls. In order to maintain a good power factor and at the same time get more energy out of the fly-wheel at light loads, the winding of that motor, which at normal load is delta-connected, can be star-connected when the rolling mill is running at half load or less. In addition to the main motor there are several other motors in use, serving different purposes, and all operated by one man from a platform.

The three-phase system has proved very satisfactory, not only on account of the good features of the induction motor with respect to safety and low cost of operation, but also with respect to energy economy. An induction motor, when running above synchronism will act as a generator and give energy back to the line. Now, when several rolling mill motors, connected to their fly-wheels, are running on the same electrical system, the energy of the fly-wheels will be electrically transmitted to the point of heaviest load. When using direct-current machinery such heavy fluctuations in load, causing sometimes the machines to run as generators, would probably lead to commutation troubles.

SCHENECTADY, N. Y. JULIUS KORNER.

Campaigning in the Institute Election.

To the Editors of Electrical World:

SIRS:—The undersigned, having been responsible for the circular which you criticise in your issue of May 12, wish to make the following statements in regard to it:

1st. The substitution of one ballot for another previously sent in is an established Institute usage, having been resorted to many times in the past by individual members. Further, a circular requesting that this be done was issued during at least one previous campaign, namely, that of 1900.

2nd. No date or place of issue was given on our circular in view of the fact that it was issued as representing the wishes of a widely distributed number of members. Furthermore, the question of date and place of issue is in no way pertinent.

3rd. We believe that at least one of you was aware of the fact that we were the authors of the circular. Further, so far as we have been able to inform ourselves, you are the only persons of our acquaintance claiming any knowledge of the authorship of the so-called "bogus circular" issued from Philadelphia. In consequence, your connection of the two was unjustifiably misleading. We have had no connection of any kind with the said "bogus circular," and are at the present time in ignorance of both its author and its source.

4th. We have obtained in the case of every name used an authorization for its use in connection with circulars to be sent out. The authorization was such that we understood that we were warranted in applying it to all circulars issued. In view of the wide geographical distribution of the names it was obviously impracticable to submit each circular to each person involved, for criticism. If any signature has been used in a way not intended it has been due to a mutual misunderstanding.

C. O. MAILLOUX.
RALPH D. MERSHON.
F. A. C. PERRINE.
H. G. STOTT.

[No one in the editorial rooms knew anything as to the authorship of the circular, or as to the responsibility for the campaign methods now admitted by our correspondents.—EDS.]

To the Editors of Electrical World:

SIRS:—In connection with the letter which I sent you last week, you mentioned the fact editorially that I informed you that I had not seen the last circular to which my name was appended in support of Dr. Sheldon's candidacy, before it was issued, and this fact is stated in conjunction with your editorial comment in such a way as to imply, apparently, that the gentlemen who used my name did so without authorization.

It is due to the gentleman who obtained my signature to the first circular, and who authorized its use as signer of the second circular, which was not submitted for my approval before it was issued, to say that his action to which I objected was due simply to a misunderstanding as to the scope of the authorization which I gave him to use my name at the time the first circular was issued. There can be no possible question of good faith involved so far as I am concerned.

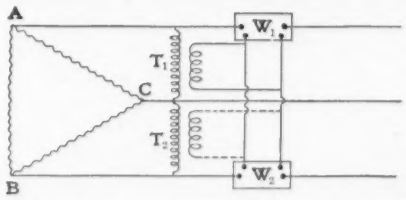
NEW YORK CITY. L. B. STILLWELL.

Measurement of Power in Three-Phase Systems.

To the Editors of Electrical World:

SIRS:—In your issue of March 17, 1906, there appeared an article on the measurement of power in a balanced three-phase system by two wattmeters having their potential coils connected across between the same two leads through a transformer. A general statement was made of this article that the power is twice the reading of the normal wattmeter minus the reading of the other. This statement is only partially true, and the interpretation of it may lead to error in some cases.

The accompanying diagram shows the connections of transformers and wattmeters, as indicated in the article referred to



CONNECTIONS OF TRANSFORMERS AND WATTMETERS.

above. With the well-known two-wattmeter method of measuring power in a three-phase system, the reading of one wattmeter will be $E\ I\ cos\ (30° + \Theta)$ and that of the other will be $E\ I\ cos\ (30° - \Theta)$. When Θ is a positive angle, that is, when the current lags behind the e.m.f., the former reading is always smaller than the latter. When the leads of one wattmeter are changed from normal to the connections shown in the diagram then this wattmeter reads $E\ I\ cos\ (90° - \Theta)$. Now, it is evident that if this latter reading be subtracted from twice the reading of the other wattmeter which has normal connections in the

circuit, the result obtained will depend upon which of the meters has retained its normal connections.

Since $cos\ (30° + \theta) = (cos\ 30°\ cos\ \theta - sin\ 30°\ sin\ \theta)$

$$= \left(\frac{\sqrt{3}}{2} cos\ \theta - \tfrac{1}{2}\ sin\ \theta \right)$$

and $cos\ (30° - \theta) = \left(\frac{\sqrt{3}}{2} cos\ \theta + \tfrac{1}{2}\ sin\ \theta \right)$,

while $cos\ (90° - \theta) = sin\ \theta$,

it follows that $2\ I\ E\ cos\ (30° - \theta) - I\ E\ cos\ (90° - \theta)$
$= 2\ I\ E\ cos\ (30° + \theta) + I\ E\ cos\ (90° - \theta) = \sqrt{3}\ I\ E\ cos\ \theta$

The interpretation of these equations is that care must be taken in determining whether the reading of the changed wattmeter must be added to or subtracted from double the reading of the wattmeter which is maintained with its normal connections. With proper care, this method of measuring power, although an inconvenient one, is applicable to the balanced three-phase system with either a leading or a lagging current.

Ithaca, N. Y. Lester A. Magraw.

[The object of the method of connection suggested in the article referred to above was to permit of the use of only one step-down transformer in a high-potential three-phase system. The author of the article called attention to the disadvantage of the method which resides in the fact that it requires a certain amount of calculation and is not applicable to a commercial polyphase watt-hour meter. The present letter emphasizes the necessity for care in making the calculations for determining the true watts. It would seem that all of these objections could be overcome if wattmeter W_2, in the illustration, be connected with its series coil in lead, C, and its shunt coil in parallel with that of wattmeter W_1. Each of these methods gives erroneous results when the system is unbalanced, either as to voltage or as to load.—Eds.]

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Testing of Transformers.—Morris and Lister.—A paper read before the Birmingham section of the (Brit.) Inst. Elec. Eng. on a method of testing transformers and transformer iron. The method necessitates the use of two similar transformers and is essentially an application of the Kapp-Hopkinson differential method of testing direct-current machines. The authors first give a characteristic diagram of a transformer which they call the characteristic triangle. They then describe the connections used in their test. They are shown in Fig.1 where T_1T_2 are two

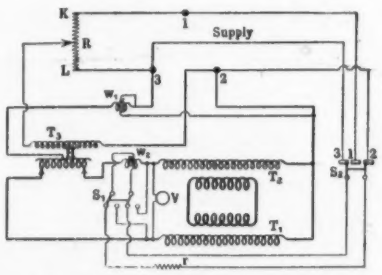


FIG. 1.—CONNECTIONS FOR TEST.

similar transformers under test; T_3 an auxiliary testing transformer; W_1 a wattmeter reading the iron losses of the transformers, T_1 and T_2; W_2 a wattmeter reading the copper losses of the transformers, T_1 and T_2 (which is also used to determine current and phase angle by the three-point wattmeter method); V is a low-reading voltmeter for measuring the secondary voltage of the auxiliary transformer; R is the main-current regulator for varying the phase angle of the current; r is the resistance for the volt circuit of the wattmeter, W_2; S_1 is a two-way, double-pole volt switch, and S_2 a three-phase volt switch. One of the supply points is joined through the wattmeter, W_1, to the middle point of the secondary winding of the auxiliary transformer. The terminal pressure of one transformer is raised, and the other lowered, the average flux density of the two transformers thus remaining normal. The primary winding of the auxiliary transformer is connected to the supply, as shown through the main-current regulator. By moving the adjustable contact of the regulator, the phase of the impressed short-circuit voltage can be varied through 60 deg. Detailed descriptions are given of the various tests which may be made with transformers.—Lond. *Elec.*, April 27.—The discussion which followed the paper is abstracted in Lond. *Elec.*, May 4.

Ventilation of Turbo-Generators.—Niethammer.—The production of a thorough and noiseless ventilation with high-speed electric machines for direct and polyphase currents is difficult on account of the small radiating surface per kw capacity. The best arrangement of the passages of the cooling air or cooling medium, therefore, requires a special study for turbo-generators. In the present article the author gives a review of the different solutions of this problem which have been proposed by different firms or inventors.—*Elek. und Masch.*, April 22.

Interpole Construction.—Hipple.—An illustrated article discussing the construction and action of the interpole type of direct-current motor.—*Elec. Jour.*, May.

Three-Wire Generators.—McIntire.—An illustrated article for direct-current generators for supplying three-wire networks.—*Elec. Jour.*, May.

Lamps and Lighting.

Zirconium Lamp.—In an article on various new incandescent lamps mention is made of the zirconium lamp of Hollefreund which is stated to consume one watt per hefner candle, the voltage being 37 to 40. The life is stated to be comparable with that of the osmium lamp. The same company also makes a "zirconium-carbon lamp" which has a greater mechanical strength than the zirconium lamp, and can be made for voltages up to 250, but its useful life is not more than 300 hours, while it consumes 2.4 to 2.5 watts per hefner candle. On the other hand the price is low, being 19 cents for ordinary lamps.—*Jour. f. Gas Beleucht.*, April 28.

Traction.

Electrolysis from Return Currents of Tramways.—Larsen.—Some notes on the work done by a special committee of the German Society of Gas and Hydraulic Engineers. Electrolytic corrosion of gas or water pipes by the stray currents from tramways has occurred in 15 out of 130 German cities. Forty-eight different cases having been observed. Special investigations have been made in Elberfeld, Strassburg, Dresden and Hamburg. In Strassburg the rail joints were very bad, the increase of resistance due to the joint being sometimes 100 per cent; on the other hand, joints welded by thermit were very good. The regulations of the German Society of Gas and Hydraulic Engineers require first as good and safe a rail joint as possible, second, a suitable arrangement of return feeders, and third, the maintenance of the potential differences in the rails within certain minimum limits. On the other hand the Association of German Electrical Engineers emphasizes that it is the potential differences in earth which are dangerous to the gas and water pipes and which should be held within certain limits. Another difference between the two societies is that the Society of Gas and Hydraulic Engineers assumes that pipe joints of high resistance may cause corrosion, while the Association of German Electrical Engineers considers them a means for protection of the pipes. *Elek. Zeit.*, May 3.

Petrol-Electric Omnibus.—A note stating that the Pieper petrol-electric omnibus is to be introduced in London. The petrol

engine drives a machine which acts either as a dynamo or a motor according to circumstances, and is used in conjunction with a small battery of accumulators. On the particular omnibus to be run on the London streets the battery consists of 25 cells of 60 amp.-hr. capacity at one-hour rate, but capable of giving about 400 amperes for short periods without undue strain. Each cell will contain 9 plates, each 5½ in. by 8 in., and the weight of the complete battery will be about 400 pounds. The conditions under which the battery works are favorable in so far as it will very frequently receive short charges, but, especially in careless hands, the discharge rate when starting on hills may be excessive. Experience will also show whether the very small battery proposed will be equal to the work without greatly exceeding the estimated figure of cost of maintenance, which is 0.2 cents per mile. The weight of the complete vehicle will not greatly exceed that of a petrol omnibus, as the added weight of the electrical equipment is to some extent compensated by the absence of the gear-box and the reduced size of the engine. It is claimed that a saving will be effected on the maintenance of tires as the starting is smoother than on the ordinary petrol system.—Lond. *Elec.*, May 4.

Steel Rolling Stock.—SHEFFIELD.—A paper read before the Tramways and Light Railways Association on European practice in the use of steel for the rolling stock. Lond. *Elec.*, April 27.

Electric Railway Engineering.—WYNNE.—The fourth of the series of articles on electric railway engineering deals with the calculation of speed-time and power curves.—*Elec. Jour.*, May.

Installations, Systems and Appliances.

Switches.—The first part of a fully illustrated description of the Hollinwood Works of the Ferranti Company, which manufacture switchgear, meters and other electrical instruments. The latest design of a high-tension remote-control switch designed for the Glasgow Electricity Works is shown in Fig. 2. *A* is the

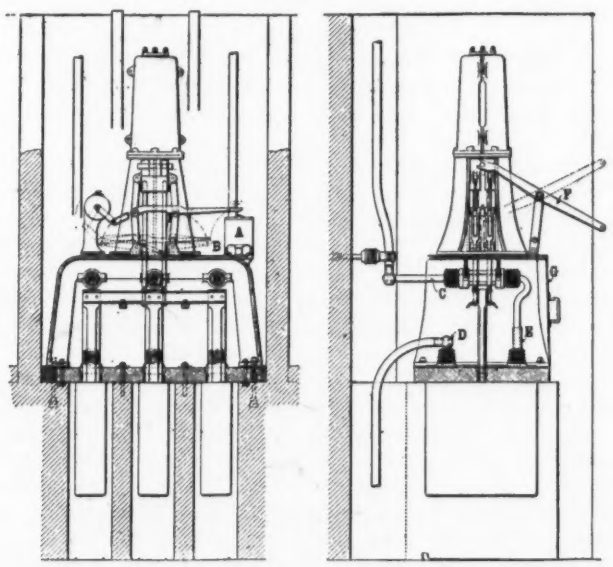


FIG. 2.—SECTIONAL VIEWS OF REMOTE-CONTROL SWITCH.

trip coil, *B*, off-position of links; *C*, a solid rod (insulated); *D*, insulation cap, to be placed over the terminal; *E*, insulation sleeve; *F*, attachment for hand operation, only in case of emergency; it is ordinarily removed; *G* is a removable cover. The cables are brought in at the side instead of at the top, which facilitates considerably the leading in, and there is a cast-iron box enclosing the terminals, with a door at the side. The tank is now supported from a slate base, instead of being held up by insulated bolts. Twenty of these switches, each capable of dealing with 6,000 kw at 6,500 volts are made for Glasgow. A new type of three-phase motor switch with no-voltage and overload relay is also described.—Lond. *Elec.*, April 27.

Central Station Business.—KIMBALL.—An article of a general nature discussing how to solicit and get new business for electric central stations.—*Cassier's Mag.*, May.

Wires, Wiring and Conduits.

Calculation of Three-Wire Networks.—FINZI.—A three-wire distributing network must have a certain elasticity; that is, when some lamps or consuming devices are disconnected or inserted, the operation of the others should not be disturbed. For the calculation of the network the difference between the maximum possible voltage and the minimum possible voltage at the terminals of the consuming device is of prime importance. With a two-wire system this voltage varies between the voltage of the central station and the same voltage minus the loss in the line. The difference between the maximum and minimum limits equals therefore the loss of voltage in the line. In a three-wire system this is no longer the case when the two halves of the network are not equally loaded. The basis of the calculation of the cross-section should, therefore, be not the maximum permissible loss of voltage but the maximum permissible variation of voltage and this depends on the difference of the load in the two halves of the network. The cross-section of the neutral conductor should be chosen on the basis of this consideration. The author gives the formulas for the three-wire direct-current system and also for three-phase lines with the phases in star connection.—*Elek. Zeit.*, March 22.

Standardizing Conductors.—The reprint of the revised rules for standardization of conductors and cables of the German Association of Electrical Engineers. They refer specially to the standardization of rubber insulated cables, of flexible conductors, etc. For copper conductors the rules are as follows: "Conductor, copper" (Leitungs kupfer) shall have a resistance not greater than 17.5 ohms for one km. length and one square millimeter cross-section at 15° C. The resistance, R_t, measured at t degrees C is to be changed to 15 degrees by the following formula:

$$R_t \div R_{15} = 1 + 0.004\ (t - 15)$$

"Copper conductors" (Kupferles tungen) must be made from "conductor copper." The effective cross-section of copper conductors is to be determined by resistance measurements, whereby the resistance of one km. length per one square millimeter is to be assumed as 17.5 ohms, as mentioned above. In cables, the length of the cable is to be taken into consideration without considering bendings of the copper. In determining whether a copper conductor is made of conductor copper, as defined above, the cross-section is to be determined by measuring the length and weight of a uniform straight piece of conductor; if there is no special determination of the specific weight the value of the same is to be assumed as 8.91.—*Elek. Zeit.*, April 19.

Fuses.—KLEMENT.—An article stating that enclosed fuses in stations are occasionally found to be too sensitive, to prevent their fusing too often, thicker fuses are sometimes employed than is proper. But experiments have shown that with this practice the line conductors may be heated to such an extent that the insulation is destroyed in a comparatively short time. The remedy recommended by the author is that the enclosed fuses should be dimensioned so that they do not fuse at double the normal current, but at three times the normal current in about one minute. The article is illustrated by numerous diagrams and tables. *Elek. Zeit.*, April 5.

Electrophysics and Magnetism.

Watt Component and Magnetizing Component of Potential Difference.—NOUGUIER.—In alternating-current calculations it is usual to consider the positive (or negative) reactance as causing the current to lag behind (or lead in advance of) the potential difference. The author endeavors to show that it is often preferable to consider the potential difference as being in advance of (or lag behind) the current and to introduce into the calculation the terms of watt component and magnetizing component of the potential difference, instead of the analogous components of the current. The consideration of the watt component and of the magnetizing component of the potential difference tends to give very simple analytical expressions for the instantaneous "watt power" and "magnetizing power"; i. e., to separate in each instance the real instantaneous power into its two parts, one furnishing the "watt energy (mechanical, termic, chemical, etc.)"

and the other the energy which is periodically accumulated in the apparatus of self-induction and capacity and periodically restored. The first part performs work outside of the apparatus under consideration, while the second part does not furnish external work and does not even increase the value of the "mean intrinsic power" which is always zero for a period comprising a complete cycle. If one employs the usual conceptions of watt component and magnetizing component of the current, it is not so easy to make this separation. The present installments deal in detail with the following problems: First, mechanism of the instantaneous exchange of power between the different apparatus of an alternating-current network; second, decomposition of the real instantaneous power into instantaneous watt power and instantaneous magnetizing power; third, calculation of the instantaneous watt power and of the instantaneous magnetizing power and of their mean values in the case of sinusoidal wave forms.—*L'Eclairage Elec.*, April 21 and 28.

Measuring Sparking Voltages.—Watson.—A paper read before the Birmingham section of the (British) Inst. Elec. Eng. The principle of the method used by the author is as follows: If a condenser be connected to a direct-current source of supply, and a spark-gap is so arranged that as soon as the condenser is charged to a certain voltage it shall spark across the gap, the condenser will automatically continue to charge and discharge so long as it is thus connected. Let the number of sparks occurring per second be noted, and also the current flowing into the condenser. If this current is divided by the number of sparks per second we have the quantity per spark expressed in coulombs. Dividing this by the capacity of the condenser, we have the potential difference at which that spark occurred, and the air broke down. In the method as used by the author a galvanometer is placed between two condensers, and the spark-gap to be tested is connected across their outer coatings; the spark-gap being connected to a Wimshurst influence machine. Across the galvanometer is placed a small auxiliary spark-gap of about 0.01 in. opening, and between this and the galvanometer are placed two small choking coils, which do not contain iron. The object of the auxiliary spark-gap is as follows: When the condensers are charging, a certain quantity of electricity passes through the galvanometer, being simply the charging current of the condensers. When these discharge, there is, of course, an exactly equal flow of electricity, which, if it passed through the galvanometer, would give it an equal deflection in the opposite direction, so that the net reading would be zero. But the discharge from two condensers is very sudden, and generally of an oscillatory nature. It cannot, therefore, pass back through the galvanometer and choking coils, but passes entirely across the auxiliary spark-gap. Thus the galvanometer measures only the charging current, and not the discharge of the condensers, and gives a steady deflection. The sparking distance is not proportional to the pressure, since the rate of increase of voltage with increase of sparking distance decreases gradually. Within moderate limits the sparking voltage of any gap is determined by the size of the smallest electrode, and the other one may be varied within reasonable limits without appreciably affecting the result. If unequal-sized electrodes are used it is advisable that the largest one should be placed on the negative pole, otherwise any advantage accruing from its use is lost. In fact, placing it on the positive pole is worse than having no large electrode at all, and causes brush discharges to commence much sooner.—Lond. *Elec.*, April 27.—An account of the discussion which followed the paper is given in Lond. *Elec.*, May 4.

Radioactivity.—Boltwood.—An abstract of an American Physical Society paper on the relative proportion of the total alpha-ray activity of radioactive minerals due to the separate radioactive constituents. The general conclusions reached in the paper are: That actinium is a disintegration product of uranium; polonium is a disintegration product of radium through the emanation; radiothorium is a disintegration product of ordinary chemical thorium, which is elementary in character, and the alpha-ray activity of minerals in radioactive equilibrium is equal to the sum of two factors, one of which depends only on the amount of uranium present and the other only on the amount of thorium contained in the mineral.—*Phys. Rev.*, May.

Canal Rays.—Austin.—An account of an experimental investigation of the emission of negatively charged particles produced by canal rays. The chief results are as follows: When canal rays strike an earthed metal surface there is a weak diffuse reflection of these rays. There is also a diffuse emission of negative particles having widely varying velocities. This negative emission increases as the angle of incidence of the canal rays increases, and is probably similar in character to the secondary negative emission produced by cathode rays.—*Phys. Rev.*, May.

Self-Induction.—Zipp.—With reference to a recent article of Peukert on determining the coefficient of self-induction by weighing, the author gives some general theoretical notes on self-induction and armature reaction, the purpose being to get a greater "uniformity of theories on secondary direct-current and alternating-current circuits."—*Elek. Zeit.*, May 3.

Constitution of Electron.—Kaufmann.—A full French translation of the German paper which was previously noticed in the Digest.—*L'Eclairage Elec.*, April 21 and 28.

Electrochemistry and Batteries.

Lead-Zinc Accumulator.—Lacau.—An account of experimental researches on the lead-zinc accumulator. While its efficiency is very satisfactory, yet the author does not think the accumulator to be practical since it is too cumbersome, needs too much attendance and is as heavy as a lead accumulator of equal solidity.—*L'Eclairage Elec.*, March 10.

Electrochemistry.—Kershaw.—An illustrated article giving a summary of the developments of electrochemical and metallurgical industries in 1906.—*Cassier's Mag.*, May.

Units, Measurements and Instruments.

Calculating Springs for Electric Devices.—Edler.—Spiral springs are often used in switches, circuit-breakers and other electrical apparatus as well as in electrical instruments. The author refers to a former paper of Dijzhoorn which gives valuable data on springs for comparatively greater stresses. In the present article the author discusses the calculation of springs for such apparatus in which relatively small forces (often below one kg. per square mm., but mostly not much more than 3 or 5 kg.) occur. The discussion is restricted to springs made of round steel or brass wire. The article is to be concluded.—*Elek. und Masch.*, April 29 and May 6.

Battery for Electrostatic Measurements.—Krueger.—For charging needles of electrometers and for calibrating electroscopes a battery giving a thoroughly constant and well-defined voltage is desirable. It is best to construct such a battery of standard cells. The author describes a battery comprising 100 cadmium dry standard cells of special construction so as to take up little space. The total voltage of the 100 cells in series is 102. The battery is divided into 5 groups each of 20 cells, the ends of each group being connected to binding posts. The internal resistance is 100,000 ohms. A current of 0.00001 ampere would, therefore, produce a drop of one volt, due to the internal resistance. It is, therefore, important to take as little current as possible from the battery. However, even if the battery is short-circuited for not too long a time, the cells recuperate their initial e.m.f. rather quickly.—*Phys. Zeit.*, March 15.

Units and Dimensions.—Juppont.—A reply to a criticism of Brylinski with respect to their controversy on a proposed new system of units and dimensions.—*L'Eclairage Elec.*, May 5.

Telegraphy, Telephony and Signals.

Microphones for Long-Distance Telephony.—Longo.—An article on two new microphones designed by Italian engineers for use on long-distance lines. The first is due to Angelini, the object being to double the microphonic circuit. The construction is shown in Fig. 3. A hard rubber disc, *a a'*, has a circular cavity in the centre which is divided into two equal parts by two small pieces of fibre or mica. The space, *b*, between these pieces is filled with a certain amount of wadding. In the two compartments of the circular cavity are disposed two metallic semi-circular sectors, *c c'*, the upper surfaces of which have a section as indicated in the illustration. This surface is in contact with the granular carbon. Two screws permit adjustment of *c c'*. Above the granular carbon the vibrating carbon plate is provided.

With this arrangement it is possible to insert between each of the sectors, $c\,c'$, and the vibrating plate a cell and the primary of an induction coil, the two secondaries being connected in parallel, as indicated in Fig. 4. With a cell of negligible resistance like

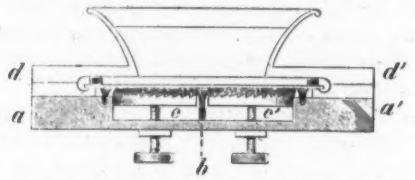
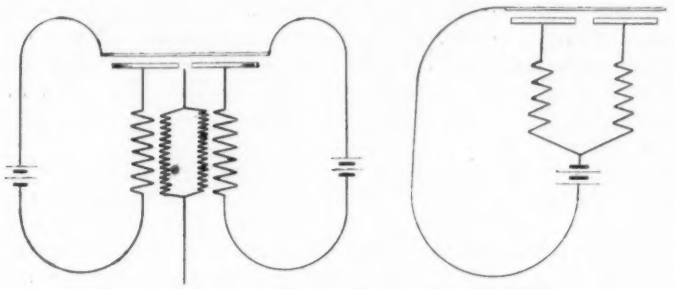


FIG. 3.—CROSS-SECTION OF MICROPHONE.

a storage cell it is possible to use the same battery for the two circuits, as indicated in Fig. 5. It is said that good results have



FIGS. 4 AND 5.—DIAGRAMS OF MICROPHONE CONNECTIONS.

been obtained with this microphone for telephonic transmission from Rome to Palermo, a distance of 1,000 km. over a line formed almost entirely of 3-mm. bronze wire and containing an underground rubber-insulated cable of a length of more than 10 km. The construction of this microphone offers no difficulties. The second new microphone mentioned is due to Majorana, but is not yet described. It is only stated that it is based on capillary attractions which produce variations of resistance in an electrical circuit permitting telephonic currents to be obtained by means of an induction coil. It is stated that a current of more than 100 milliamperes may be used with this transmitter for a wave of 500 periods. Some general considerations are added in which the author expresses his belief that with higher voltages the mutual inductance of the lines might prove more troublesome and that the real solution of the problem of long-distance telephony is to be found rather in proper construction of the transmission line than in the design of special microphones. —*Jour. Telegraphique*, April 25.

Standardization in Telephony.—McBERTY.—A paper read before the Western Soc. of Engineers on standardization of methods and appliances in telephony. The engineer should determine for each locality, in view of the electrical losses which will be encountered in varying proportions of the probable connections, the minimum grade of transmission permissible in view of the cost of conductors. The acceptance of a single standard applied uniformly to all cases would not seem to be in the direction of adequate planning. The standard of transmission should, therefore, provide a sliding scale, variable within wide limits and adjustable to actual conditions. The engineer fails to exercise his function when he accepts unreservedly, standards of performance which are established under unknown conditions in other places. Proposals to standardize appliances now being generally agitated, are rather to reduce telephonic appliances to a few types for uniform application. The important considerations tending toward so-called standardizing of appliances are, reduced cost of manufacture, reduced quantity of stocks, increased promptness of supply and universal knowledge of uses and maintenances. The most important disadvantage is that standardizing prevents the natural selections which operate where a variety of forms are present to bring the fittest to the fore. Standardizing of appliances is safe and even necessary for an operating company with an established business, but undesirable for a newcomer compelled to make his way on a showing of good reason for his existence. A related disadvantage of standardizing appliances appears in the inertia of ideas and of plant, which result from limiting the types of appliances. In so far as it is possible, the selection of standard appliances should be based upon costs rather than prices. An account of the long discussion which followed is also given.—*Jour. Western Soc. Engineers*, April.

Wireless Telegraphy in a Certain Direction.—MARCONI.—A reprint of the Royal Society paper on methods whereby the radiation of electric waves may be mainly confined to certain directions, which was noted in our issue for April 21. At the transmitting station the method consists simply in stretching the great part of an ordinary direct excited air wire horizontally in the direction in which the waves are to be transmitted. From the numerous curves given in the paper it is seen that the strength of signals received by stations on lines at an angle with the horizontal air wire is approximately proportional to the square of the cosine of the half angle. It is noteworthy that over long distances where unfortunately no precise measurements could be made, experiments point to a higher degree of concentration forward than is shown in the short range experiments, the results of which are quantitatively given. The converse problem of receiving signals only from selected direction is solved in exactly the same way. Two advantages follow from the complete power of discriminating in azimuth. First, the source of the waves received can be located, and, second, undesired or obnoxious signals or disturbances, if not on the line of communication, can be shut out from the receiver. The first advantage would be extremely advantageous for the mariner, and the second would be welcome in every application of wave telegraphy. A peculiar fact is that the signals were received best when the horizontal air wire was directed away from the sending station. Fig. 6 shows the insulated horizontal air wire, $A\,B$, while Fig. 7 gives the quantitative results of measuring the current in microamperes at the earthed end of the receiving conductor under the conditions of direction of the transmitting air wire indicated in the small left-hand diagram.

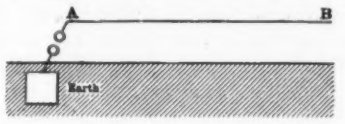


FIG. 6.—DIAGRAM OF AIR WIRE.

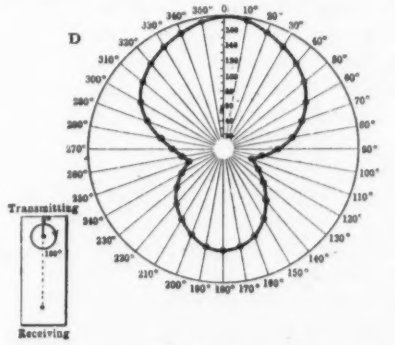


FIG. 7.—CURVE OF OBSERVED CURRENT AT EARTHED END.

It will be seen that the transmission was best for an angle of zero, that is, when the direction of the transmitting wire was away from the receiving station, and that the transmission was a minimum when the transmitting horizontal wire formed an angle of 110 degrees on either side with the "zero line" just mentioned. In the particular experiments of the last figure the transmitting conductor was 1.5 meters above ground, and had a length of 60 meters horizontal and was rotated around the earthed point all the way through 360 degrees. The receiving conductor was vertical and fixed, its height being 18 meters. The distance of transmission was 260 meters.—Lond. *Elec.*, May 4.

Automatic Printing Telegraph.—An article on commercial applications of the Murray automatic page-printing telegraph system, which has now been working for about two years between Edinburgh and London, and a complete duplex installation is being constructed for London-Dublin. The system has also been working for more than a year between Hamburg and Berlin, and it is now working between St. Petersburg and Moscow. The Indian Telegraph Department has ordered a complete

duplex equipment for use between Calcutta and Bombay, a distance of 1,200 miles, and the Austrian administration is having an experimental set constructed for trial between Vienna and Prague. Some information is given on experiments made in Russia. Among others, a telegraphic loop line was made up from St. Petersburg to Waroslavl to Kazan to Moscow and back to St. Petersburg, a distance of 1,926 miles, of 5-mm. iron wire (600 pounds per mile), with repeating station at Waroslavl, Kazan and Moscow. The speeds obtained were indefinite, as one of the sections was not in good condition. The Wheatstone system got about 35 to 40 words a minute, and at times a little higher. The Murray system got 56 words per minute, and 10 messages were transmitted and printed. They were found to contain two wrong letters—a remarkably good result considering the condition of part of the line. This is the first time on record that a printing telegraph has worked over such a distance as 1,900 miles, even of copper wire, and in this case the wire was iron. The highly favorable results obtained with the Murray system during these trials are explained by the inventor as being due chiefly to the employment of the Baudot alphabet, which is shorter than the Morse in the ratio of 5 to 8. The inductive interference from neighboring wires was very severe on the long lines and was an important factor in limiting the speeds obtained. Some notes are given on the telegraph service in Russia, which is said to be efficiently managed.—Lond. *Elec., Elec. Rev.*, May 4.

Capillary Telephone.—Boruttau.—An article on the history, construction and operation of the capillary telephone, which is based on the change of the capillary constant between mercury and electrolyte with variation of the electrical potential (i. e., the same principle on which the capillary electrometer is based). A number of different constructions are described.—*Phys. Zeit.*, April 1.

BOOK REVIEWS.

The Universal Electrical Directory. London, 1906: H. Alabaster, Gatehouse & Co. Cloth, 1,520 pages.

This standard and useful publication once more makes its welcome appearance, growing in value with bulk. It contains the names and addresses of members of the electrical and allied trades and professions throughout the universe. For facility of reference it is divided into four sections; i. e., British, containing 14,227 names; Colonial and general, containing 4,385 names; Continental, containing 7,938 names; U. S. A., containing 7,029 names, making a total of 33,529 names. Each of these sections is again divided into alphabetical and classified sections and in the case of the British a Geographical Section is also given, by which a glance at any town shows all firms of any importance therein. The sections are indicated by a thumb index, which renders them perfectly easy of access.

A strikingly useful feature of the book is the information regarding electricity works in Great and Greater Britain. The systems of distribution and of voltage are given, the engineer's name and capacity of plant, and in the case of alternating current, periodicity and phase are included. It would be a boon if this could be done by some one for other colonial and foreign plants.

Telegraphic addresses and telephone numbers will be found in the alphabetical sections, and particulars as to capital, etc., of limited companies are given in the British alphabetical section. To meet a growing want the book is now published in two forms, "A," containing the British and Colonial and General Sections only, and "B" containing the Continental and U. S. A. Sections.

Berechnung und Entwurf Electrische Machinen, Apparate und Aulagen. III Bund. Elektrische Schaltaulagen und Apparate samt Grundlagen zur Projektierung elektrischen Aulagen. By Prof. Dr. F. Niethammer. Stuttgart: Ferdinand Enke. 572 pages, 609 illustrations, 13 tables.

While this present volume of Dr. Niethammer's is made up largely from trade publications, it cannot be denied that it contains much interesting matter, and that it will be frequently referred to, not alone by engineers, but by those who for one reason or another may have occasion to post themselves on the state of the art at the time of its issue.

The subject matter of the various chapters forming Part I and occupying the first 460 pages is the accessories for electric light and power plants, namely, switchboards as a whole, switches, fuses and circuit-breakers, instruments, lightning arresters, rheostats and miscellaneous devices.

With the exception of the instrument chapter, which the author has treated extensively in another work, and has passed over with but brief mention in the present one, the various sections are quite full and, in a colloquial fashion, exhaustive, their value being much enhanced by the co-operation which has evidently been extended by many of the large European and American companies, who have been liberal in their contributions of photographs and detail drawings. A section which, while extending over but eight or nine pages, will prove of undoubted value in many instances, gives the over-all dimensions, net weights and prices of standard sizes of the various apparatus of which the volume treats. These data are conveniently arranged and seem accurate.

Part II of the book gives a mass of greatly condensed information to enable the preliminary calculation of plants for supplying electricity for lamps and motors. The electricity consumed per inhabitant in average towns and how this is distributed for residence, manufacturing and traction work, are the first subjects treated. Next come the total installation costs for plants of various capacities and with different prime-movers. Following are average prices of the various items making up a plant, including buildings, machinery, electrical accessories, sub-station machinery, generating prime-movers, etc., etc. After this, in turn, are further data on the speeds, bulk, weights and costs of machines and their accessories; and like data on boilers, chimneys, generators, transformers, storage batteries, conductors, etc., etc.—in fact, all the elements of a complete plant and distributing system. Finally there are the operating expenses, itemized in much the same fashion.

If all of the information in this Part II is as accurate as checks made by dipping in here and there at random indicate that it may be, an engineer with a slim stock of experience can take up this book and make up about as close an estimate of what a given station proposition under European conditions means as one who has been in harness for many years. Even for American workers, with some slight revision in the light of the different conditions applying, the data will in many cases prove acceptable to a degree. It is an excellent book to have at hand for reference.

Tests of an Interpole Railway Motor.

By G. Herbert Condict.

A number of tests have recently been made by the Electro-Dynamic Company, of Bayonne, N. J., on interpole motors for railway work with very satisfactory results. In one case the motor was overloaded more than 300 per cent and there were no signs of sparking or flashing at the brushes. The value of this characteristic in railway service is of the utmost importance, as the work is intermittent and often motors of great capacity are employed merely to surmount some excessive grade, or for quick acceleration. With the interpole motor the limiting factor is not commutation, as with the ordinary motor, but is the heating. As the extra heating of the motors can be readily taken care of by forced draught, it follows that a motor of much smaller size may be used for a given service, or a far greater power can be furnished by a motor of a given size. This last feature is of the utmost importance. A smaller motor for a given power gives greater clearance from the ground. This is a factor of great importance in suburban and heavy electric railway work, because the limited space underneath the car precludes, with the ordinary design, the use of motors having more than a comparatively small capacity.

With commutator troubles practically eliminated, with the size of the motor per horse-power reduced and with its ability for operating with weak fields and at a wide range in voltages, the

interpole motor is the most practicable design for trunk line conditions. The ideal method is to equip each car with powerful motors so as to obtain the maximum speed with high voltages (2,000 to 3,000 volts) upon the trunk lines and to divert the same cars on to city or branch tracks when they reach their destination. In the city the same motors and the same controllers

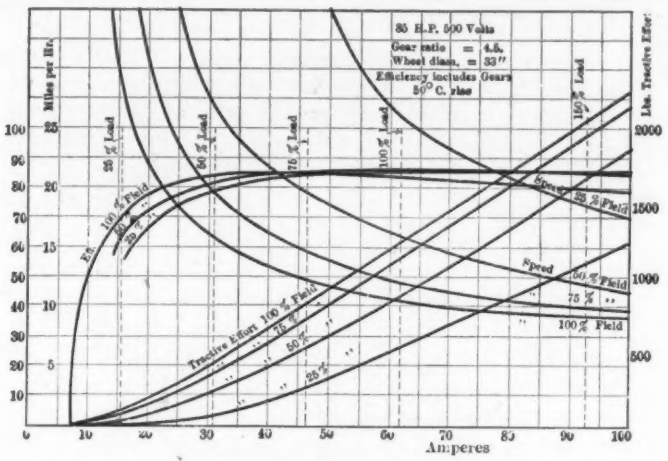


FIG. I.—PERFORMANCE CURVES.

can be used. Under these conditions the traveler, instead of leaving the car at the railway station, a mile or more from his hotel or the center of the town, will ride from the city system in one town to the city system in another and thus comfortably and easily be landed at his hotel or doorstep. It was considered a great improvement when baggage could be checked from the traveler's house to its final destination, but it is of much greater importance to be able to pass from one's own home to the final end of the journey, not only without change, but at the highest speed. The combination of the multiple unit system with the interpole motor makes this commercially possible.

The accompanying characteristic curves of a 35-hp interpole

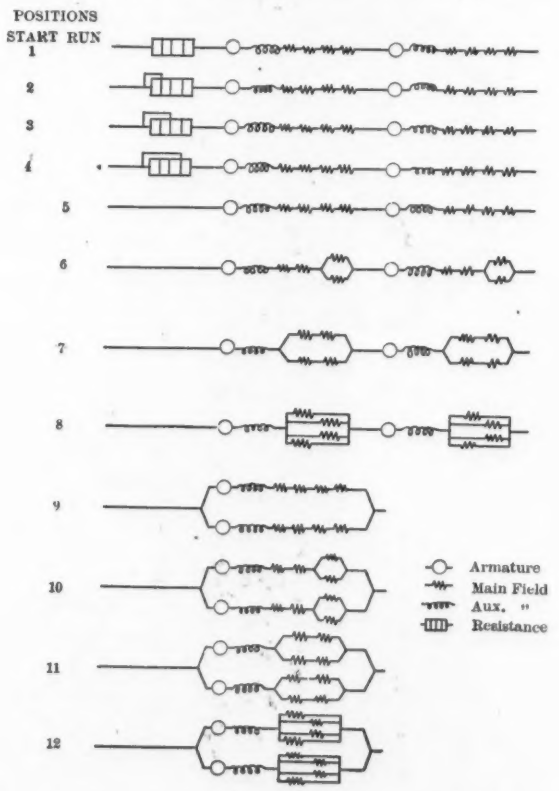


FIG. 2.—SERIES PARALLEL CONNECTIONS OF INTERPOLE MOTORS.

motor in this connection cannot fail to be of interest, as giving the very remarkable performance of this motor when operated under weak field conditions. On account of the absence of commutator troubles, the field of the interpole motor, as stated, can be weakened to almost any extent, thus delivering high speeds, and at the same time the motor can be run at excessive overloads. Both of these advantages can be secured with a high degree of efficiency, as shown by the curves in Fig. 1. It will be noted that the loss in the gears is included. The motor from which these curves were taken has a weight of less than 1,500 lb.

In Fig. 2 is shown one of the various possibilities of control of the interpole railway motor. This is a series parallel system in which full use is made of the increased speeds obtained by weakening the fields of the motors. After starting up in series with resistance, the motors are brought into the running series position (No. 5) and from this point on have an almost indefinite number of efficient running positions, in this case eight, which may be obtained without the use of any resistance. A great improvement in economy of power consumption when compared with the ordinary type of railway motor will thus be secured.

Recent developments have demonstrated that the interpole motor, as used in railway work, has not yet reached its final stage and some surprising results may be anticipated.

Test of a Kitsee Storage Battery.

BY E. W. STEVENSON.

A test of a Kitsee storage battery was recently made by the writer as a demonstration before the board of trade of the city of Wilkes-Barre, for the purpose of showing its advantages.

FIG. 1.—PASTED POSITIVE PLATE.

Judging from the curve shown in Fig. 2 its merits are certainly considerable, and it deserve more than a passing notice.

Fig. 1 is a photograph of the positive plate. The reason for the large capacity of the cell will be seen at a glance. The construction is such that most of the plate is made up of active material, and, though apparently this would render the plate weak structurally, it seems to have no such effect. The grid containing

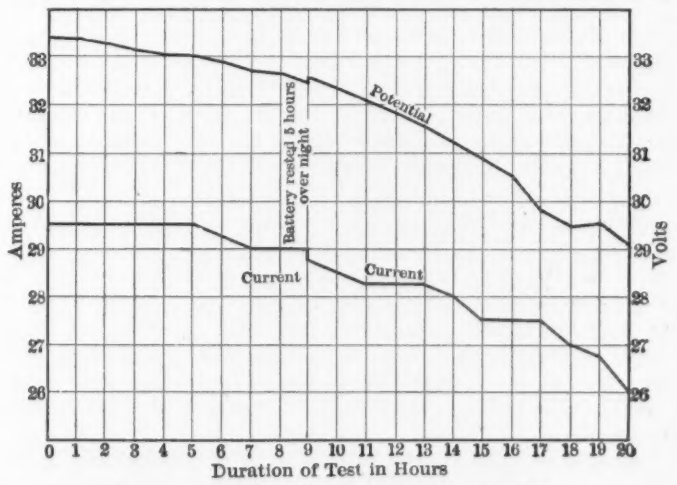


FIG. 2.—TEST OF 16-CELL STORAGE BATTERY.

the active material is held in a framework of hard rubber, and is therefore very light.

According to the published figures of all the other companies, this cell, taking the type tested as a standard (17 plates, each 7¾ in. by 9 in.; total weight of cell complete, 125 lbs.) has the

large increase in capacity of from 40 to 60 per cent over any other battery of a similar size in the market.

At the conclusion of the twenty-hour test noted in the diagram, the battery was submitted to a very severe strain, double load being drawn off it for 45 minutes. Even with this the average potential per cell did not drop to 1.5 volts.

The cells were hand made, and were therefore not of the best construction. The writer is of the opinion that with proper mechanical devices for manufacture, a much better cell could be produced.

The proper representatives of the Lehigh Valley Railroad, the Del., Lack. & W. R. R., and other railroad men were present at the test and expressed their satisfaction at the behavior of the battery.

The Allis-Chalmers Steam Turbine.

Last week in an account of the first runs of the Allis-Chalmers steam turbine in the Williamsburg station of the Brooklyn Rapid Transit Company, reference was made to the remarkably small injury found to be caused by foreign substances in the cylinder, the presence of which substances might have been thought sufficient to cause grave damage. Below we give details of a later experience of this kind, which illustrates in a remarkable manner the abuse the turbine will successfully withstand.

Shortly after starting up the turbine on the morning of April 25, a peculiar noise was heard in the turbine cylinder, and the machine was stopped and opened up. It was then found that a

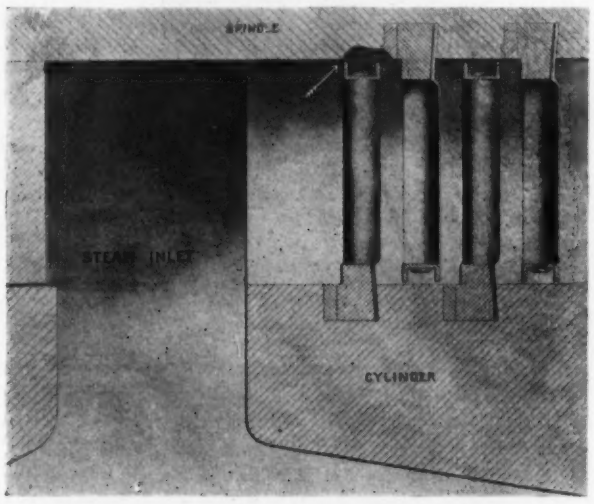


FIG. 1.—SECTION THROUGH FIRST ROW OF BLADES.

piece of steel had gotten between the spindle and the shroud of the first row of stationary blades, where, acting like a lathe tool, it had cut into the body of the drum for a width of about ⅜ of an inch, and for a depth of nearly 3/16 inch, this cut being alongside of and opening into the groove which holds the first row of spindle blades, as shown in Fig. 1. This had loosened the calking strip which held the ring of blades in place. For a distance of five or six inches this strip had moved partly out of its groove, thereby loosening the ring of blades, which under the influence of centrifugal force, had bent outward and the channel-shaped shroud ring had rubbed so hard in the bore of the cylinder that the flanges of the shroud ring had worn almost down to the beads of the riveting which holds the ring to the blades. The fact of greatest interest is that under these severe conditions not a single blade had come out or even become loosened or injured in any way.

As it would have been unsafe to attempt to hold blades in the damaged groove, and it not being convenient to keep the turbine out of service long enough to make permanent repairs, the erecting engineer removed this one ring of blades, closed the cylinder and immediately put the turbine back into service.

An examination of the removed ring of blades (Fig. 2) showed that one-half was as good as when put in, while the other half was damaged only as to the wearing away of the flanges of the shroud ring. With a new half shroud ring this ring of blades would be in perfect condition.

An investigation as to the cause of the mishap showed that the piece of steel which cut the grooves in the shaft was apparently one of the leaves of a pocket knife handle. A further

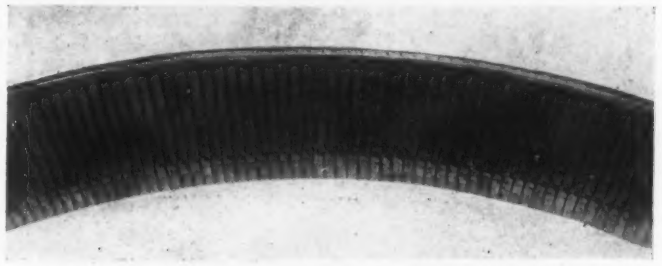
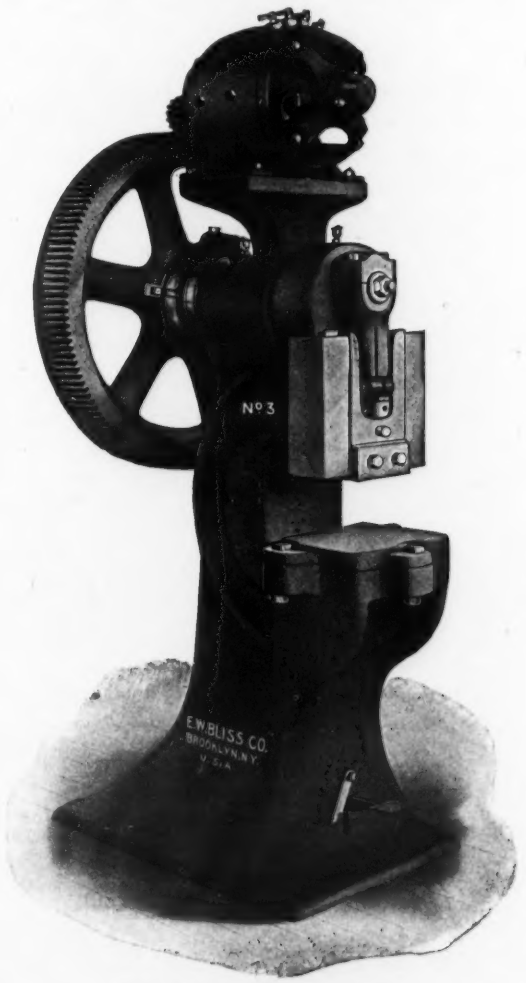


FIG. 2.—PORTION OF RING OF BLADES FROM SPINLLE.

search discovered the remainder of the metal parts of a large jack-knife, but the outer covering of the handle had disappeared. The large blade of the knife showed that it also had been rubbing hard. The turbine had not been opened up since March 30, and the knife must have gotten into the turbine at that time or previously, as it would be impossible for it to get into the interior except when the turbine was opened up.

Press with Electric Motor.

The demand for electric motors for driving nearly all classes of machinery is constantly increasing, and this increase is very



ELECTRICALLY-DRIVEN PRESS.

noticeable in the large number of power presses now being fitted for the electric drive. In this kind of machinery it is often advantageous to have the motor located in such a position

that it is entirely out of the way of the operator, and also to have the machine occupy no more floor space than is absolutely necessary.

To provide for both of these features the E. W. Bliss Co., of Brooklyn, has recently supplied one of its "Stiles" presses with the motor arranged as shown in the accompanying illustration, which, it will be noted, is a very simple and efficacious way of accomplishing the desired results. The starting box is attached to the far side of the press within easy reach of the operator, who has perfect control of the machine at all times by simply depressing the foot treadle to cause the slide to descend and raising his foot to make the slide stop. In addition to the motor equipment on this press it is interesting to know that the machine itself is very largely used in the manufacture of electrical instruments, fittings, parts, etc.

Blast Furnace Gas Engine Development.

The Carnegie Steel Company has made a long step in the right direction by its recent adoption of gas engines to utilize surplus gas from its furnaces for the generation of power needed in the electric driving of mill machinery. Sometime ago the company contracted with the Westinghouse Machine Company, of Pittsburg, builders of large engines and turbines, for some large blowing engines to be driven by blast furnace gas. For the purpose of conducting preliminary experimental work an engine of 350 hp running at 150 revolutions with 30-in. stroke was installed and has since made a remarkable record for itself under the severest possible tests for efficiency, reliability and durability. The two gas blowing engines are now under construction at East Pittsburg for the work at the Edgar Thompson Furnaces, Bessemer.

These will be twin tandem units with Slick air blowing "tubs" arranged in front or vis-a-vis and with fly-wheel interposed between the two sides of the engine. Each of these blowing units will have a capacity of 25,000 cu. ft. of free air per minute, operating against a normal blast pressure of 18 lb. and running at a speed of 60 to 75 r.p.m. When higher pressure is demanded by the furnaces the valve gear of the engine may be so altered as to deliver air under pressures up to 25 lb. per sq. in. in proportionately less quantity. These engines are of the heavy-duty, double-acting type as standardized by the Westinghouse Machine Company, and will be among the largest ever constructed for use with blast furnace gas.

Very recently the Carnegie Steel Company has contracted with the Westinghouse Machine Company for another blast furnace gas engine unit similar in design to the blowing units above mentioned, except that the engine will drive a direct-connected electrical generator for the purpose of augmenting the present power service at the Bessemer works. The gas engine will have the same stroke as the blowing unit, viz.: 54-in., and operating at a normal speed of 75 r.p.m. will develop approximately 2,500 brake hp on blast furnace gas. The generator will be a 1,500-kw, direct-current machine connected in parallel with the steam-driven dynamos at the present Edgar Thompson power plant.

Portable Electric Hoists.

The electric hoist shown in Fig. 1 has been designed for use where the bottom block is exposed to much heat, being fitted with a chain in place of the more commonly employed wire rope. These hoists are equipped with a controller, which provides for five speeds where the delicate handling of the load is necessary. In places where such refinement is not needed the controller is arranged for only two speeds. In the illustration the controller is operated by means of pendant cords. On account of the presence of the solenoid brake on the hoisting mechanism, the hoists can be controlled from a distance when desired, permitting the controller to be detached and mounted independently of the hoist at any convenient place. The hoisting mechanism will swivel a full turn in either direction around the suspending hook without injurious twisting of the wires. Where it is necessary for the hoist to swivel continuously, however, turntable collector rings are employed. The terminals pass into the top hook, and

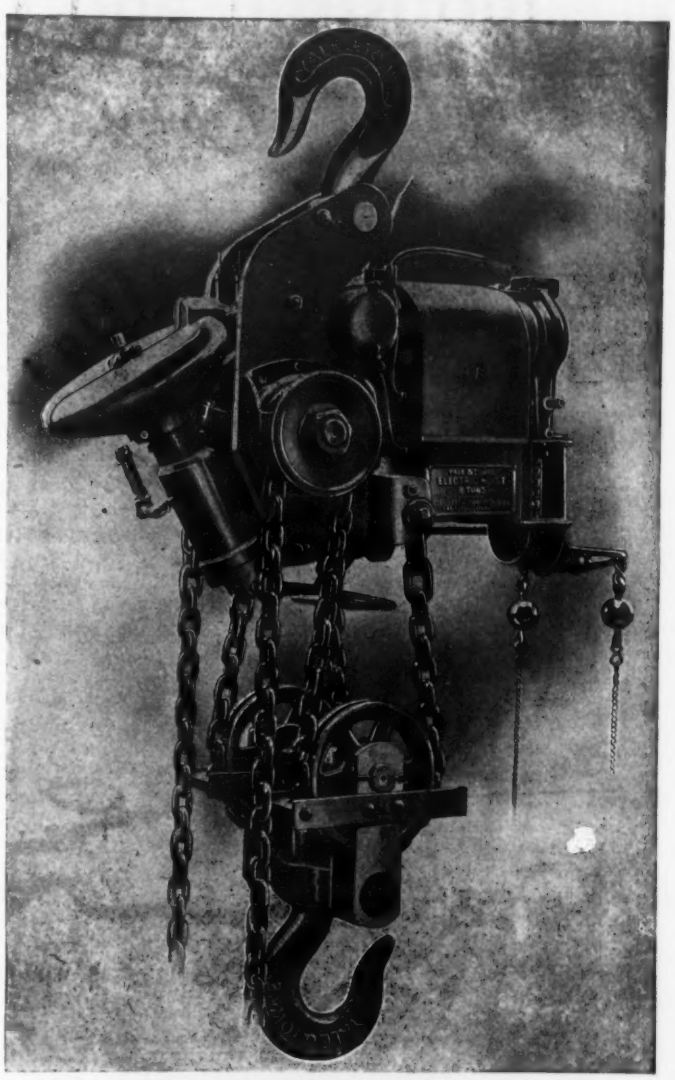


FIG. 1.—PORTABLE ELECTRIC HOIST.

FIG. 2.—TURNTABLE COLLECTOR RINGS.

thence to the insulated rings, contact to the latter being made by two brushes as shown in Fig. 2.

These hoists are made by the Yale & Towne Manufacturing Company, 9 Murray Street, New York.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Excellent reports of business conditions were the rule last week and the situation is thus summarized: Retail trade has expanded with warmer weather and the settlement of labor troubles; jobbing reorder business is of a full seasonable volume, San Francisco demand being a feature; fall orders are equal to, and in many lines in excess of, last year at this period; industry, except in some sections of the soft-coal field, is as active as ever before, and the return tide of currency from the country is evidenced by increasing Western bank deposits and perceptibly easier money. Demand for speculative purposes has fallen off and collections are better. Lack of moisture in portions of the winter wheat belt is responsible for the first irregularity of the season in crop reports, but spring wheat and corn are doing well. Railway earnings show good gains; building is active, and there were large sales of lumber, hardware, paints, glass and other material, and the iron and steel industry, while showing some irregularity in foundry-pig prices, due probably to the molders' strike, draws great confidence from the large volume of orders booked for steel rails for next year's delivery. Collections tend to improve. The demand for steel rails for 1907 delivery was the feature of the iron and steel markets. Demand for structural material is quieter, but mills are very busy on old contracts. Coal and coke are lower, supplies being ample and demand less active. Copper is higher, and the market reflects steady and large demands for home and foreign account. One large Western producing interest on Friday refused market specifications for 3,000,000 pounds of electrolytic wanted for August shipment. This producing interest closed its books for August copper at the opening of the week. Among the larger producers June and July bookings have been closed, and there is not much August copper to be had in heavy tonnages. Casting copper for nearby delivery is not to be had in large quantities from makers of prime brands. The domestic market quotes Lake, 18⅞ to 19c. for August; electrolytic, 18¾ to 18⅞c. for August and September. Prime casting grades are 18⅝ to 18¾c., nominally at thirty days, but commonly understood to be later as to shipments. The business failures, as reported by *Bradstreet's*, are at a low level. The number last week was 161, against 162 the week previous and 191 in the corresponding week last year.

WESTINGHOUSE LOCOMOTIVES.—In the construction department of electric locomotives at the East Pittsburg factories of the Westinghouse Electric & Manufacturing Company there is a very busy time at present. Within the last week or two orders came into this department for no less than 55 electric locomotives. Some of these are for mining plants and will be used for hauling coal in the pit. Others are for manufacturing plants, where the electric locomotive is now finding extensive use in the transportation of material from the shops to the railroad siding, and a very large number are for railroad companies for hauling freight. These orders for electric locomotives do not come from one part of the country but are shipped everywhere. The Youghiogheny & Ohio Coal Company, of Cleveland, has ordered five; the Ziegler Coal Company, of Ziegler, Ill., three; the Berwind-White Coal Mining Company, of Windber, Pa., four; the Copper Queen Consolidated Mining Company, of Colorado, twelve; the Mammoth Copper Mining Company, of Mayville, Cal., one; the Seattle-Boston Copper Company, of Seattle, Wash., one; the St. Louis, Rocky Mountain & Pacific Railway Company, three; the Pennsylvania Salt Manufacturing Company, of Natrona, Pa., three; the Pittsburg Plate Glass Company, of Charleroi, Pa., four; the Pocahontas Colliery Company, of Pocahontas, Va., three; the Washington Railways & Electric Company, of Washington, D. C., one freight locomotive and the Tennessee Copper Company, of Isabella, Tenn., three.

C. H. BROWN ENGINE COMPANY.—The C. H. Brown Engine Company is the name of a $75,000 Massachusetts corporation in process of organization at Fitchburg, Mass., which will buy the land, buildings, equipment and patent rights of C. H. Brown & Company. The incorporators are: Moses J. Perault, Charles B. Smith, W. E. Putney. Alpha Garth, Edward J. Welch, Frank E. Brown, George P. Grant, Jr., Charles F. Irish, George H. Cutter, William L. Sargent, of Fitchburg, and Walter F. Brown, Boston. At a meeting of the incorporators these temporary officers were elected: President, Walter F. Brown; secretary and treasurer, William L. Sargent. Directors: M. J. Perault, E. J. Welch, W. F. Brown, F. E. Brown and W. L. Sargent. Articles of incorporation will be filed with the commissions of corporations in Boston this week. The company will continue to manufacture the Brown automatic cut-off engine, and expects to employ 100 skilled mechanics.

BELL TELEPHONE OUTPUT.—The American Telephone & Telegraph Company's instrument statement for April and four months shows the following output of Bell telephones:

April:	1906.	1905.	1904.	1903.
Gross output...	206,557	174,207	102,907	104,429
Returned	65,357	44,981	42,335	43,491
Net output ..	141,200	129,226	60,572	60,938
Four months—				
Gross output...	733,041	475,775	404,475	410,390
Returned	244,019	153,971	151,325	160,137
Net output...	489,022	321,804	253,150	250,253
Total output	6,187,280	4,910,962	4,032,667	3,400,573

This is equivalent to 3,093,640 stations.

LARGE WHITE CONTRACT.—A contract has been made whereby J. G. White & Company, of New York, are to build a new high speed interurban line costing $2,000,000, between Rochester and Lockport, for a syndicate represented by Frederic Nichols, E. R. Wood and Sir Henry M. Pellatt, of Toronto. The contract covers the entire construction, inclusive of track, overhead work, distributing system and five sub-stations. The right of way will be graded for two tracks, although the construction of only a single track is provided for in the initial contract. The contract includes also the rolling stock, which will be of the established standard for high speed interurban service. Work will be begun immediately.

WARREN ELECTRIC MANUFACTURING COMPANY.—The receivers of the Warren Electric Manufacturing Company have filed in the Common Pleas Court a summary of receipts and disbursements from the date of their appointment, October 28, 1905, to April 16, 1906. The account shows cash on hand and accounts receivable of $45,550. Receivers' certificates were issued and sold to the amount of $13,000 and there are accounts payable to the amount of $5,286. The surplus under the administration of the receivers is $36,265. The principal items in the accounts receivable are claims of $26,351 against the U. S. Navy Department and $14,250 against the Consolidated Lighting Company, of Sandusky.

FOREIGN TRADE—The Bureau of Statistics, Department of Commerce and Labor, reports imports and exports of merchandise for April and for ten months ending April 30, as follows:

April:	1906.	1905.	1904.
Imports	$107,327,038	$95,636,142	$83,521,882
Exports	144,491,909	129,358,229	109,880,405
Excess of exports.	$37,164,871	$33,722,087	$26,358,523
Ten months ending April 30—			
Imports	$1,020,881,835	935,072,990	829,231,975
Exports	1,488,393,999	1,275,059,368	1,277,715,480
Excess of exp.....	$457,512,164	$339,986,378	$448,483,505

WIRELESS SHIPPING EQUIPMENT.—The Massie Wireless Telegraph Company, of Providence, R. I., has a contract for equipping the Enterprise Transportation Line, plying between New York and Fall River, and the system will be put in operation at once. Land service will be given the boats from the Massie stations at Wilson Point and Point Judith.

THE GENERAL ELECTRIC COMPANY has acquired a large tract of land between the Erie Canal and the Mohawk River. The company has under consideration, it is said, the erection of a large blast furnace. With the opening of the new barge canal, the ore will be brought direct from the mines to the furnace and made into pig iron.

POWER IN WASHINGTON.—The Simikameen Falls Power & Development Company, of Oroville, Wash., Mr. H. W. Johnson, manager, is developing a power transmission plant of 1,000 hp, and is now in the market for motors ranging in size from 5 to 25 hp.

ELECTRIC LOCOMOTIVES.—As to the effect of electric railway work on manufacturing of steel, etc., it is stated that the 35 Westinghouse electric locomotives ordered by the New York, New Haven & Hartford Railroad Company, for service between the Grand Central Station and Stamford, will consume 5,950,000 lb. of American steel.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market toward the close of the week became heavy, being influenced by the weakness of Pennsylvania Railroad shares on the revelations brought out regarding irregularities in the conduct of its coal traffic. Prior to this the general tendency had been toward an advance under the influence of easy conditions in the money market, although the trading throughout was professional and narrow. In industrials there were no special features, apart from the relative steadiness of the United States Steel issues, a reaction in the International Pump shares, and a break in National Lead, caused by the fact that the dividend on the common stock, the first which has been declared thereon since 1901, was only 1 per cent instead of a larger amount. The local traction securities were irregular, but showed some strength on the favorable accounts of earnings which they exhibit. A large trading was done in Brooklyn Rapid Transit at figures ranging between 82¼ and 84⅞, the closing price being 83¼. Metropolitan Street Railway certificates closed at 114, and Interborough-Metropolitan, common and preferred, closed at 51½ and 84½, respectively, the former being a net loss of 2¾ and the latter of 1¾. The electric stocks were generally weak and losses on the week's business were recorded at the close. Allis-Chalmers common declined 1¼ points net, closing at 55¾, and preferred 1¾, the last quotation being 109¾. General Electric made a net gain of 1 point, closing at 168¾, and Westinghouse dropped 4 points, the last quotation being 154. Western Union Telegraph closed at 92¼, which quotation is a fractional decline. Interborough Rapid Transit, on the curb, closed at 232, a net gain of 1 point on the week's business. Mackay Companies advanced 1⅜, closing at 72. The curb market, except for pool operations in two or three stocks, such as Mackay and Chicago Subway, which were bid up sharply, was without special feature. Prices were run up a little early in the week, then sagged off, as efforts were made to liquidate. Liquidation, in fact, was the keynote to the market. Outsiders were not disposed to buy many stocks, and traders, being suspicious, held off. Following are the closing quotations on the Stock Exchange May 22:

NEW YORK

	May 15	May 22		May 15	May 22
Allis-Chalmers Co.	20⅝	20¾	General Electric	167⅛	167
Allis-Chalmers Co. pfd.	56	55¼	Hudson River Tel.	...	...
American Dist. Tel.	*39	*39	Interborough Rap. Tran.	232	226
American Locomotive	67¼	68⅝	Mackay Cos.	72	74⅛
American Locomotive pfd.	114	114⅛	Mackay Cos pfd.	74	73¾
American Tel. & Cable	90	90	Marconi Tel.	...	...
American Tel. & Tel.	138	137	Metropolitan St. Ry.	115	116
Brooklyn Rapid Transit	83¾	81⅜	N. Y. & N. J. Tel.	...	...
Electric Boat	18	18	Western Union Tel.	92¼	92¼
Electric Boat pfd	65	65	Westinghouse com.	153	158
Electric Vehicle	11	11	Westinghouse pfd.	...	...
Electric Vehicle pfd.	18	18			

BOSTON

	May 15	May 22		May 15	May 22
American Tel & Tel.	139	137⅛	Mass. Elec. Ry. pfd	65	68⅛
Cumberland Telephone	117¼	..	Mexican Telephone	...	...
Edison Elec. Illum.	246⅛	246	New England Telephone	138	...
General Electric	168¼	168	Western Tel. & Tel.	...	...
Mass. Elec. Ry.	18⅛	19¾	Western Tel. & Tel pfd.	90	90

PHILADELPHIA

	May 15	May 22		May15	May 22
American Railways	51½	52	Phila. Electric	8	7⅞
Elec. Co. of America	11¼	11⅛	Phila. Rapid Trans.	26⅛	25⅛
Elec. Storage Battery	73	72	Phila. Traction	99	98¾
Elec. Storage Battery pfd.	...	..			

CHICAGO

	May 15	May 22		May 15	May 22
Chicago City Ry.	150	160	National Carbon	88	89
Chicago Edison	...	...	National Carbon pfd.	120	120
Chicago Subway	...	58	Union Traction	...	...
Chicago Tel. Co.	...	122	Union Traction pfd	...	...
Metropolitan Elev. com.	27⅛	26			

* Asked

INDIANA TELEPHONE DEALS.—During the present month considerable progress has been made toward a merger of interests in the independent telephone field in Indiana. At a recent meeting in Fort Wayne the independent plants of Peru, South Bend and the Delaware and Madison County telephone companies, capitalized at $10,000,000, agreed upon plans and terms for an alliance with the St. Louis independent interests. At a similar meeting in Vincennes, the controlling interest of the Knox County Home Telephone Company, owned by W. R. Gardner and others, of Toledo, Ohio, was pooled with the Central Home Telephone Company, of Louisville, Ky., of which the Toledo people have become directors. The Home Company has 1,300 subscribers in Vincennes and gives free service over the whole of Lawrence County in Illinois just across the Wabash River. The local stockholders are greatly pleased with the new alliance. A similar alliance has been effected at Washington, Bloomington, Seymour and Bedford exchanges, which have been operated independently. By entering this pool they obtain long-distance service with the Kinloch, of St. Louis, the Central, of Louisville, and other cities allied with them.

DEVELOPMENT IN UTAH.—It is announced from Salt Lake City that the Utah Light & Railway Company is to be taken over by a $25,000,000 corporation, composed of English and American capitalists. The new company will also acquire the Ogden Street Railway and build an electric line from Juab County, Utah, to Oneda County, Idaho. It will be known as the Intermountain Consolidated Railroad Company, and will be incorporated both in Utah and Idaho. The board of directors will include H. H. Vreeland, New York City; Baron d'Oissel, Paris; Sir Thomas Jackson, London; William G. Rathbone, Manchester, England; Alexander McKenzie, Ottawa, Canada; Henry Dupont, Paris; Beresford Hope, London, and a number of Utah men, among them Governor John C. Cutler. The enterprise will be financed through the Intermountain Trust Company, incorporated in Utah and Idaho. If this policy is completely carried out the sale of the traction interests will be followed by the sale of Mormon Church stocks in banks, sugar factories, the great Z. C. M. I. department store, and many smaller enterprises. It will be a commercial revolution profoundly affecting the political and social life of the State.

CHICAGO EDISON.—Advices from Chicago state that the lighting committee of the city council has recommended for passage, with certain modifications, the ordinance reducing the rates charged by the Chicago Edison and Commonwealth Electric companies. The rates are fifteen cents per long hour the first two years and thirteen cents the next three and ten cents per short hour the first year, nine cents the second, eight cents the third and seven cents the fourth and fifth. A discount of 1 per cent per kilowatt hour is to be deducted from bills paid within ten days. The companies are authorized to consolidate, but when consolidated 3 per cent of the gross receipts of both are to be paid to the city as compensation. To expedite the sale of its bonds the franchise of the Commonwealth Electric is amended so as to run to its successors or assigns. One amendment provides that the rates shall never exceed the schedule fixed in the ordinance as outlined above.

TRI-CITY CONSOLIDATION.—A consolidation is under way of all the street railway, gas and electric lighting properties in Davenport, Ia.; Rock Island, Ill.; Moline, Ill., and East Moline, the new organization to be known as the Tri-City Railway & Light Company, with a proposed capital stock of $12,000,000, of which will be issued $2,600,000 cumulative 6 per cent preferred and $9,000,000 common; with $6,000,000 of 5 per cent bonds issued and $3,000,000 bonds reserved. During 1906-7 it is proposed to expend $1,500,000 in various improvements. Messrs. J. G. White & Company estimate for 1906 gross earnings of $1,485,000; operating expenses, etc., $843,000, and $642,000 net, leaving $289,490 available for dividends after taking $352,510 for bond interest. These figures will show a marked gain for 1908.

CINCINNATI GAS & ELECTRIC.—The Consolidated Gas & Electric Company, recently organized by New York capitalists, has acquired control of the Cincinnati Gas & Electric Company, in accordance with plans already noted. The new company guarantees the Cincinnati company 4½ per cent dividends on its stock for two years, 4¾ per cent the next two years, and 5½ per cent a year thereafter. The authorized capital of the Consolidated Gas & Electric Company consists of $10,000,000 of 6 per cent preferred stock and $6,000,000 of common. The Guaranty Trust Company, the Windsor Trust Company and George W. Young & Company are interested.

DIVIDENDS.—The Syracuse Lighting Company has declared the regular quarterly dividend of ½ of 1 per cent on the common, payable June 1. The directors of the Kansas City Railway & Light have declared the regular preferred quarterly dividend of 1¼ per cent, payable June 1.

CANADIAN CAPITAL FOR U. S. A.—Montreal and Toronto capitalists have purchased $1,300,000 of the preferred stock of the Tri-City Railway & Light Company, of Davenport, Ia., and the stock will be listed on the Montreal Exchange.

GENERAL NEWS.

Construction Notes.

CENTREVILLE, ALA.—This town is now lighted by electricity from the new electric lighting plant.

MONTGOMERY, ALA.—The Montgomery Traction Company has its $40,000 street railway barn and shops well under way, and will soon begin other improvements to its system.

GADSDEN, ALA.—The City Council has entered into a contract with the Alabama City, Attalla & Gadsden Railway for electric lighting franchise for fifteen years. The company is required to build a plant to cost at least $90,000, and it is understood that the plant to be erected will go far beyond that. The franchise is limited to ten years, but it runs five more if satisfaction is given. The company is also building considerable new track.

LOS ANGELES, CAL.—The Sunset Telephone Company is considering the advisability of placing its wires in conduits along Olive Street.

SAN FRANCISCO, CAL.—The California Street Cable Company is preparing to rebulid its power plant on California and Hyde Streets, which was destroyed by the earthquake.

SAN DIEGO, CAL.—The Home Telephone Company will make immediate improvements in the back country system and to that end Manager Woodridge has been authorized to construct an extension to Cuyamaca, which will represent an outlay of $25,000.

SAN FRANCISCO, CAL.—The Bay Counties Railway Company filed notice of change of its principal place of business from Napa to San Francisco. The company was recently incorporated with $1,000,000 capital stock to build a railway forty-five miles in length through Marin, Sonoma and Napa Counties.

PASADENA, CAL.—On May 3 the citizens voted in favor of issuing $125,000 in bonds for the installation of an electric system. It is stated that the city will, in all probability, buy up the Edison Electric Company's holdings in Pasadena, if they can be acquired at a reasonable figure. The Edison Company does not maintain a power house, but merely the system of wires by which the power is distributed. In case the city should buy the local system it would still have to build a plant.

DENVER, COL.—The Northern Colorado Power Company, which recently purchased the Boulder Light & Power Company, has been reorganized and the capital stock increased from $50,000 to $3,000,000. It is stated that the company will take over the electric light, gas and steam plants at Cheyenne and Ft. Russell, and the plant of the Consumers' Electric Company at Lafayette. The company will construct as soon as possible a 10,000-hp plant at Lafayette, and ultimately increase it to 35,000 hp. The plant at Boulder will be discontinued as soon as the plant at Lafayette is completed. It is the intention of the company to consolidate a number of plants in northern Colorado and southern Wyoming towns, and to supply light, power and fuel to the towns and mines in the territory where its lines extend. It will also furnish power to the Denver, Boulder, Fort Collins and Greeley branch of the Colorado & Southern Railroad as soon as it is electrified.

CANAAN, CONN.—The machinery of the Canfield Auto Company is now operated by electricity, power being furnished by the Berkshire Power Company.

HARTFORD, CONN.—The Common Council has voted to accept the proposition of the Consolidated Railway Company to double the track on Sisson Avenue and lay an additional track on New Park Avenue.

HARTFORD, CONN.—The Hartford Electric Light Company will soon be able to supply its patrons with the graphitized filament incandescent lamps to take the place of the 16-cp incandescent lamp now in use.

MOODUS, CONN.—The financial interests back of the Salmon River Power Company have taken preliminary steps toward the construction of an electric railway between Moodus and East Haddam. It is estimated that it will cost $100,000 to construct and equip the road.

MIDDLETOWN, CONN.—The Rhode Island Contract Engineering Company (F. H. Hoadley, vice-president and manager, Providence, R. I.) has secured the contract for complete installation of the plant of the Salmon River Power Company and will purchase contractors' equipments. Cost of work proposed, $500,000.

ROCKVILLE, CONN.—The Rockville Gas & Electric Company has just completed the expenditure of $40,000 in the enlargement of its plant and installing new street lamps. The company is now extending a line to Stafford Springs, where connections will be made with the Stafford Springs Electric Light Company, which is under the same ownership as the local concern.

PENSACOLA, FLA.—Stone & Webster, of Boston, Mass., have acquired the electric railway and lighting systems of this city through the purchase of all securities of the Pensacola Electric Terminal Railway Company and the Escambia County Light & Power Company. A new company, under the management of Stone & Webster, will be organized to operate these systems. The railroad system now includes about 12 miles of track operated by electricity and 7 miles by steam power. It is proposed to convert at once the latter line to electricity. The new company will improve the entire property and extend the system to meet the requirements of the growing population.

SOCIAL CIRCLE, GA.—An election will soon be held to vote on the question of issuing bonds for an electric light plant.

OCILLA, GA.—The new municipal electric lighting plant was put into operation for the first time May 16, and is giving satisfaction.

FITZGERALD, GA.—The capacity of the municipal water and light plant has recently been doubled, and extensive improvements are contemplated in extending the lighting service and water mains.

CULDESAC, IDAHO.—The Culdesac Milling Company will soon install an electric lighting plant. The company is now installing a 55-hp Leffel water wheel, which will increase the power capacity to 100 hp. Bids have been asked for a 500-light dynamo, and work on the construction will soon commence. The plant, exclusive of the water power, will cost about $3,000.

PEORIA, ILL.—The Interstate Telephone Company will spend fully $100,000 in improvements on its plant in this city this year.

ELGIN, ILL.—The Elgin & DuPage Electric Railroad Company has changed its name to the Chicago-Elgin Electric Railroad Company.

MILAN, ILL.—S. S. Davis and associates contemplate constructing a dam on Rock River for developing water power for electrical purposes.

JOLIET, ILL.—Plans are being made by President R. R. McCormick for a water power plant to be constructed by the drainage board south of this place, to cost about $2,000,000.

MAPLE CITY, ILL.—The Mainland syndicate, which holds the contract for lighting the streets, has been asked to submit estimates on three different propositions for lighting the city during the twelve months.

KANKAKEE, ILL.—Plans are being considered for the construction of a large power and lighting plant in this city. H. G. West, of the Consumers' Coal Company, of Chicago, and A. J. Vernier are the promoters.

ATHENS, ILL.—The Athens Electric Light Company during the past six months increased its alternating load to full capacity, and expects to install a 60-kw or larger machine in the near future. J. P. Stutzman is superintendent and electrician.

SPRINGFIELD, ILL.—The Springfield, Clear Lake & Rochester Interurban Railroad Company will issue bonds for $60,000 to secure the aid of local subscribers. Work on the road is progressing rapidly and several miles of grading have been completed out of Rochester. J. E. Melick is president and G. E. Hemenway, treasurer.

GRANITE CITY, ILL.—The Alton, Granite & St. Louis Traction Company, the Alton Gas & Electric Company, the Granite City Railway lines and allied corporations in Granite City, are now controlled by the East St. Louis & Suburban Railway Company, of which L. C. Haynes, of East St. Louis, is general manager. It is said that a new corporation with a capital of $14,000,000 will hold the stock of the various corporations. The names of the operating companies will be retained.

FLORA, IND.—A company has been organized here to construct and install a modern electric light and water works plant. The company will file articles of incorporation under the name of the Flora Light & Water Company.

COLUMBUS, IND.—The Citizens Telephone Company is considering the construction of a new branch exchange at East Columbus. Two plans are being considered, one being to extend the cable to the suburb and the other to build the exchange, on which estimates are being made.

HUNTINGTON, IND.—The management of Riverside Park has found it can secure light from the Huntington Light & Fuel Company at a figure cheaper than it can handle its own plants and has contracted with the company for between 300 and 400 lamps to be erected in Riverside Park and to be put into operation as soon as possible.

INDIANAPOLIS, IND.—The Louisville & Eastern Railway recently bought by Messrs. Elliott, Fuavre & Gales of this city, has filed a mortgage for $2,000,000 at Frankfort, Ky. The mortgage provides that not more than $450,000 shall be spent for the extension of the road, for twenty-two miles. Work on the extension will soon begin.

LAFAYETTE, IND.—The Lafayette Street Railway Company, which is a part of the Fort Wayne & Wabash Valley Traction Company, has been granted a franchise for eighty-six years to operate cars on certain streets by the Board of Public Works. The interurban company has secured a franchise for fifty years to operate its cars in the city. It is said that the latter grant will assure the immediate building of the Logansport-Lafayette branch of the road.

NOBLESVILLE, IND.—The Hamilton County Telephone Company has been organized to operate a rural telephone line in Hamilton County. The plan is to have exchanges in the small towns which have not yet been served by telephone companies, with headquarters in this city and in Sheridan. Six new exchanges will be put in; those at Hortonsville and Eagletown to be the first constructed. Fletcher Jessup, of Hortonsville, is president.

TULSA, I. T.—A street railway company has recently been organized here by local and outside capitalists. It has a capital stock of $200,000, with $10,000 paid in, and has a cash bond to put up with the city guaranteeing to complete ten miles of electric railway in twelve months. L. F. Parker, of St. Louis, Mo., is interested in the company and will probably be its first president.

MUSCATINE, IA.—Frank X. Schaefer has petitioned for a franchise for an electric light and power system.

SHENANDOAH, IA.—John A. Masters is reported to have purchased a controlling interest in the electric light plant here, and will rebuild the same.

BOONE, IA.—The power plant of the Newton & Northwestern Railroad Company will be located at Fraser, and work on the construction of the plant will begin without delay. The J. G. White Company will have charge of the work.

WICHITA, KAN.—The Wichita Gas, Electric Light & Power Company has decided to construct a new plant.

DOWNS, KAN.—C. S. Dittman is contemplating putting in an electric light plant here for his own use and for the town. A plant of sufficient capacity to light the town would cost from $10,000 to $18,000.

HUTCHISON, KAN.—The foundation is being laid for the power house building for the People's Water, Light & Power Company. This plant will also furnish power for the Hutchison Interurban Railway Company.

LAWRENCE, KAN.—Bids are wanted by H. B. Fears, superintendent, Haskall Institute, Lawrence, for furnishing and delivering as required, five electric motors, aggregating about 23 hp, with transformers, etc., set in place ready to run.

INDEPENDENCE, KAN.—It is announced that A. C. Stitch, with a company of capitalists, will organize a company for the purpose of erecting an electric light plant. The city is being canvassed for customers and the plant will be erected at once. It is to cost about $10,000.

PARSONS, KAN.—The Parsons Electric Light & Power Company is planning extensive improvements and additions to its plant within a short time which will cost about $35,000. The company will add to its equipment new boilers and dynamos and put in additional switchboards, transformers, steam connections, etc.

LEXINGTON, KY.—The Lexington-Winchester Interurban Electric Railway in Kentucky has secured the necessary rights of way and will probably begin work on the new line this summer.

SHELBYVILLE, KY.—The town of Shelbyville has granted a 99-year right of way to the Louisville & Eastern Electric Railway for an interurban road to be completed within one year. A line to Eminence is also to be constructed.

MORGAN CITY, LA.—The Morgan City Improvement Company will increase the capacity of its plant by adding two 75-kw direct-current machines and will extend its lines. Hugh Young is president.

SOUTH PARIS, ME.—The citizens of this village have decided not to build a municipal electric lighting plant at present.

WESTBROOK, ME.—The Westbrook Electric Light & Power Company is installing two 100-hp rotary converters and other necessary equipment to furnish power for the paper mill.

BANGOR, ME.—The power plant of the Bodwell Water Power Company, which is now being constructed at Old Town, is nearly completed, and is expected to be in operation in a few weeks. It is said that the plant will have a capacity of 3,000 hp, and that the current will be transmitted to this city. The charter of the company enables it to build transmission lines and to sell power for all purposes throughout Penobscot County.

AUGUSTA, ME.—The Kennebec Light & Heat Company is making extensive improvements to its plant. It has just installed a 750-hp steam turbine, direct connected to a 500-kw alternating-current dynamo. Three dynamos of 200-kw capacity each are to be installed. The whole system is to be changed from single to three phase, separate wires to be used for street lighting, inside lighting and power. The company uses both water and steam power. It furnishes electricity for Augusta, Togus, Hallowell and Gardiner.

MECHANICS FALLS, ME.—The controlling interest of the Mechanics Falls Water & Light Company has been purchased by Libbey & Dingley, of Lewiston, Me. The new management will at once assume control. Power will be supplied from the Deer Rips power station at Auburn, the present power station will be held in reserve in case of accident. Work will begin at once on the installation of the transmission line from Auburn. To accommodate this increased demand on their power, Libbey & Dingley have contracted with the General Electric Company for another unit to be installed at the Deer Rips power house at Auburn. This unit will be of 1,500 hp. This will give a total of 4,000 horse-power, with space for the installation of two additional units when required. In the installation of this new unit larger wheels will be used. At the annual meeting of the Mechanics Falls Water & Electric Light & Power Company, the following officers were elected: President, H. M. Dingley, of Lewiston; treasurer, W. S. Libbey, of Lewiston; clerk, J. E. Parkhurst, of Lewiston; directors, H. M. Dingley, W. S. Libbey, J. E. Parkhurst, Fred G. Gordon and Harry A. Edgecomb.

BOSTON, MASS.—The city of Medford has granted a franchise to the Boston & Lowell Interurban Railway Company.

GLEASONDALE, MASS.—The town of Gleasondale is now lighted by electricity. The current is furnished by the municipal electric light plant of Hudson.

WHITMAN, MASS.—The Edison Company is rapidly extending its service in the town, not only furnishing additional lights for the town, but also to many business houses and residences.

WESTFIELD, MASS.—George Pettibone, manager of the municipal electric light and power plant, has recently installed a 5-hp motor in the machine shop of Moore & Moore, on Crary Avenue.

ARLINGTON, MASS.—At a town meeting May 15 F. A. Bisbee, Harry Hornblower and Franklin Wyman were appointed a committee to investigate the question of municipal lighting.

HOLYOKE, MASS.—J. Louis Perkins will operate his paper mill in South Hadley by electricity. As soon as the new machinery is installed power will be furnished by the Holyoke Water Company as soon as the machinery is placed.

ORANGE, MASS.—The Orange Electric Light Company is planning the construction of a new steam power plant, to be located at Wendall Depot, in connection with the water power station, as the power furnished by the old Grove Street station is inadequate at times of low water.

HOLYOKE, MASS.—The quarterly report compiled by D. W. Kenney, City Auditor, upon the business of the municipal lighting department for the quarter ending February 28, showed an increase of $7,657 over the corresponding quarter in 1905. The increase in receipts for gas was $2,388, while the increase in electric light and power was $5,269.

GREAT BARRINGTON, MASS.—At a recent meeting of the fire district it was voted to rescind the vote taken at the annual meeting, to appropriate $3,500 for street lighting, and to appropriate $4,421.50 in its place. The Great Barrington Electric Light Company has agreed to furnish 239 32-cp incandescent lamps at $18.50 per lamp per year, instead of $19.25, the price paid last year.

BOSTON, MASS.—The railroad commissioners have issued an order authorizing the Worcester & Blackstone Valley Street Railway Company to issue additional stock to the amount of $140,000. At present the company has a capital stock of only $60,000. The new stock is to be sold to the present stockholders at $100 a share, the income to be devoted to reducing the floating indebtedness.

TAUNTON, MASS.—The County Commissioners of Bristol County will receive bids at the Court House in Taunton, until 10.30 a. m., May 28, for furnishing and installing the electric lighting fixtures in the building for the registry of deeds for the northern district of Bristol County. Drawings and specifications may be seen at the office of the County Commissioners, County Court House, Taunton, Mass.

TEMPLETON, MASS.—The citizens voted on May 14 to appropriate a sum not to exceed $15,000 to establish an electric light plant. An electric light committee was elected consisting of Eugene Lincoln, of Templeton; C. Aylmer Smith, of Baldwinville, and Charles H. Leathe, of Otter River. The present plan of the committee is to use the money appropriated to erect poles and string wires through the town, and to purchase current from the Gardner Electric Company, of Gardner, Mass.

GRAND RAPIDS, MICH.—The Grand Rapids Brass Company has installed a 200-hp gas producer plant and generator, and about 90 electric motors.

MEMPHIS, MICH.—The Village Council has passed an ordinance granting S. D. Lester, of Sandusky, the exclusive privilege of establishing and maintaining an electric light and water works system in this village.

BAY VIEW, MICH.—The electric lighting plant of the Bay View Camp Ground Association will probably be enlarged in the near future. At present it consists of a 45-kw alternator supplying 16 and 32-cp lamps during the summer season.

CONSTANTINE, MICH.—Plans and specifications are nearing completion and bids will soon be asked for the construction of the proposed power plant on St. Joseph River at Constantine, for H. L. Hartensten. H. von Schon, of Detroit, is the engineer.

ANN ARBOR, MICH.—The Michigan State Telephone Company has been awarded a contract by the board of regents for the installation of a complete telephone system for the university buildings and campus for the State University at Ann Arbor.

MUSKEGON, MICH.—The West Michigan Interurban Company has announced that Eastern capitalists have agreed to furnish the money for the construction of the electric railway from this city to Hart. James K. Flood, of Hart, is interested in the project.

TRAVERSE CITY, MICH.—A company has recently been organized in this city for the purpose of furnishing electric power. The company has a capital stock of $50,000 fully subscribed. The officers are Daniel J. Albertson, of Kalamazoo, president; William H. Thirly, vice-president; William H. Umlor, secretary, and Anton W. Bartak, treasurer.

LANSING, MICH.—The Lansing water and electric light plant (municipal) has recently installed a circuit of alternating-current arc lamps. It will put in a sub-pumping station of two million gallons capacity to be run by an electric motor. The plant has also put in the last of a contract of 600 Nernst lamps for stores. C. D. Dodge is superintendent.

PENTWATER, MICH.—The Pere Marquette Power Company is constructing a dam and power house on the Pere Marquette River about 25 miles east of Pentwater. The plant when completed will have a

capacity of about 3,000 hp. The company will build about 75 miles of transmission line, and proposes to furnish electricity for lighting and power to the various towns through which its lines extend. The work is well under way and is expected to be completed about October 1. J. N. Cotton, of Hart, Mich., is president.

NEW ULM, MINN.—The Minnesota Central Telephone Company contemplates installing a central energy system.

STAYTON, MINN.—George H. Woodgate has purchased the Enterprise telephone system and will extend it.

HOKAH, MINN.—R. D. Sprague, of Caledonia, is reported to be interested in developing the water power here for electrical purposes.

BOVEY, MINN.—F. McCormack, of Duluth, has submitted a proposition to install water works and an electric light plant at this place.

STILLWATER, MINN.—The Western Gas & Investment Company, of Chicago, Ill., owner of the local electric light plant, is preparing to develop power on the Apple River.

RUSH CITY, MINN.—An election will be held to vote on issuing bonds for developing the water power; probable cost, $15,000. The engineers are Claussen, Burch & Pillsbury, of St. Paul.

DULUTH, MINN.—Work has commenced of putting the wires of the electric, telephone and telegraph companies underground, in accordance with the ordinance recently adopted by the City Council.

MANKATO, MINN.—The Mankato Gas & Electric Light Company is planning extensive alterations and improvements in its lines in the business section of the city. The company is endeavoring to interest the merchants in electric signs, and has secured the services of an expert to solicit business and design signs for prospective patrons.

ST. PAUL, MINN.—The Union Manufacturing Company has petitioned the city to extend its franchise for electric light and power to include the western half of the city. The company is ready to agree to furnish electricity at a maximum rate of 8 cents per kw-hour for motors and 14 cents per kw-hour for lamps, with a minimum charge of $1 per month.

VICKSBURG, MISS.—Hon. Oliver C. Catchings has petitioned for a franchise to operate a street railway in this city. A new company is being organized by Harry K. Johnson, Frank Markham and the Helgason Brothers. The company also intend to build a new power plant.

ST. LOUIS, MO.—The Sodeman Heat and Power Company, of St. Louis, has filed a statement with the Secretary of State to show it had increased its capital stock from $50,000 to $100,000, all the increase paid.

ST. LOUIS, MO.—Thomas B. Carter, Supervisor of City Lighting, has been authorized by the Board of Public Improvements to prepare a comprehensive plan for a complete electric plant for lighting the entire city.

GRAFTON, MO.—The Village Council has granted L. T. Westrich a franchise to erect and operate an electric light plant in this place. A company has been organized with a capital stock of $10,000 to build the plant.

BOWLING GREEN, MO.—An ordinance has been passed by the Council granting the Pike County Electric Light & Power Company the right to erect, maintain and operate an electric light and power plant in this city.

LINCOLN, NEB.—The Citizens' Street Railway Company will increase its capital stock to $100,000.

HAVELOCK, NEB.—P. T. McCere has been granted a franchise for the erection of an electric lighting plant in this city.

LINCOLN, NEB.—The contract for the new light and power plant at the university has been let to Olson & Lawrence. Work on the building will begin at once.

WEST POINT, NEB.—The Independent Telephone Company, operating a telephone system around Beemer and Wisner, will petition the City Council for permission to establish an exchange in this city.

TECUMSEH, NEB.—Judge S. P. Davidson and P. H. Hopkins have been appointed by the Commercial Club to propose to the City Council a special election to bond the city for $10,000 for an up-to-date electric light plant.

GRAND ISLAND, NEB.—The Matthews Electric Company, of Kansas City, Mo., has secured the contract for constructing the water works and an electric light plant for Grand Island. Engineer, W. K. Palmer, Kansas City, Mo.

SEARCHLIGHT, NEV.—W. B. Atwell, of the Searchlight Western Telegraph Company, announces that construction will soon commence on the electric power plant in this district.

EXETER, N. H.—A receiver has been appointed for the Exeter, Hampton & Amesbury Street Railway Company on petition of bondholders who wished to foreclose their mortgages. The railway is a part of the New Hampshire Traction Company's system.

NEWARK, N. J.—The Sanitary Ice Company has submitted a proposition to the new city hall commissioners to light the new city hall. The company agree to install a plant at a cost of $35,000 and furnish energy for lamps and motors for the building for a period of ten years at five cents per kw-hour, and at the end of ten years to turn the plant over to the city free of cost.

RATON, N. M.—The Colorado Telephone Company has recently purchased a lot on Park Avenue, and will at once commence the erection of a building to be used for its plant and offices. The plant will not only be enlarged but modernly equipped, involving an expenditure of about $70,000.

WILLETS POINT, N. Y.—Bids will be received until June 12 by Capt. George H. McManus, Constructing Quartermaster, U. S. A., Ft. Totten, for installing electric light fixtures in 13 buildings at this post.

TROY, N. Y.—The United Traction Company purchased the franchise which was recently sold at auction, to construct and operate an electric railway on Hoosick Street from Fifteenth Street to the city line. The price paid was $598.25.

LITTLE FALLS, N. Y.—The Herkimer County Light & Power Company, of Little Falls, has entered into a contract with the Utica Gas & Electric Company, of Utica, to purchase electricity from that company, the minimum charge to be $10,000 yearly.

SAYVILLE, N. Y.—The Sayville Electric Light Company is extending its lines to Great River, and will light a number of the country residences in that section. It is stated that the company will also install electric lamps in and around the Oakdale station.

BINGHAMTON, N. Y.—Alderman Bromley has announced that work will soon begin on the plans for the municipal electric lighting plant. It is planned to have the plant ready for operation when the lighting contract expires with the Binghamton Light, Heat & Power Company.

BUFFALO, N. Y.—It is announced that the control of the Buffalo Southern Railway Company, which operates the Buffalo, Hamburg & Aurora Electric Railway and Buffalo, Gardenville & Ebenezer Electric Railway, has passed into hands of new interests. It is said that the new management will extend the road to East Aurora in the near future, and make other improvements.

ROCHESTER, N. Y.—A contract has been made whereby J. G. White & Company, of New York, N. Y., are to build a new high speed interurban line, costing $2,000,000, between Rochester and Lockport for a syndicate represented by Frederic Nicholls, E. R. Wood and Sir Henry M. Pollatt, of Toronto. The contract covers the entire construction, inclusive of track, overhead work, distribution and five substations; also the rolling stock. The right of way will be graded for two tracks, although the construction of only a single track is provided for in the initial contract. Electricity will be secured from the Ontario Power Company, at Niagara. Work will be commenced immediately.

NEW YORK, N. Y.—After four years of fighting before the Board of Aldermen and the Board of Estimate, the New York & Port Chester Railroad Company has secured a franchise for an electric railroad in the Bronx. The Port Chester Road is to pay the city $8,000 a year for the first five years after the signing of the contract; then $13,000 a year for the next five years, and then $35,000 a year for the next fifteen years. From the date of the commencement of the operation of any part of the railroad until the end of the first five years of the grant the company is to pay an additional sum of five and four-tenths cents per annum per linear foot of single track within the present boundaries of the City of New York, and for the next succeeding five years an additional sum of 7 7-10 cents per annum per linear foot of single track, and for the next succeeding fifteen years an additional sum of 20 cents per linear foot. The term of the franchise is twenty-five years, with a provision, on a readjustment of price, for a renewal of twenty-five years.

MOREHEAD, N. D.—The city is considering the question of installing a 150-kw unit in the municipal electric plant, to furnish electricity for a day power circuit.

STEUBENVILLE, OHIO.—The board of education has decided to install an electric lighting plant in the new high school building. The outfit will include a 40-hp engine and a 25-kw generator.

CINCINNATI, OHIO.—The village of St. Bernard has issued $5,000 bonds for the purpose of installing additional machinery in the municipal electric light plant. Geo. E. Schroder is village clerk.

YOUNGSTOWN, OHIO.—F. A. Kaercher and Christopher Deibel, of this city, have purchased a tract of land on West Boardman Street and propose to erect an independent electric light and power plant.

OBERLIN, OHIO.—The Oberlin Gas & Electric Company has declared a dividend of 6 per cent on preferred stock. The business of the company is growing so rapidly that it has just placed contracts for machinery to double its equipment.

TOLEDO, OHIO.—The Tuscarawas County Telephone Company has been purchased by the syndicate headed by James S. Brailey of Toledo. The company has increased its capital stock and bonded indebtedness to $350,000 and will make improvements.

EATON, OHIO.—The Dayton & Western Traction Company is negotiating for the purchase of the Eaton Electric Light, Power & Ice Manufacturing Company. The company plans to place a substation at Eaton and operate the lighting plant from this.

AKRON, OHIO.—J. Milton Dyer, of Cleveland, is preparing estimates as to the cost of installing an electric lighting and steam heating plant to be placed in the jail building and to furnish light, heat and power for all the county buildings, including the new court house.

PORTSMOUTH, OHIO.—The Portsmouth Home Telephone Company is planning to install a new switchboard, cables, telephone instruments and other improvements at a cost of $80,000; contracts for material are to be placed at once and the improvements are to be completed the latter part of September.

HASKINS, OHIO.—A. Chester, of Bowling Green, is endeavoring to secure a franchise for an independent telephone system in Haskins.

CLEVELAND, OHIO.—The Perry-Payne Company has been granted a permit for the proposed additions to its power plant on Oregon Street, which will cost $50,000.

DELAWARE, OHIO.—The Delaware Electric Light & Power Company has elected A. J. Lyon, president; Adolph Frank, vice-president; J. G. Rosenthal, secretary; and M. Miller, treasurer. The company plans to make some important improvements to its systems.

FREMONT, OHIO.—The Fremont-Yaryan Company, operating an electric light and hot water heating station, has issued a trust deed for $75,000 to secure a bond issue of like amount. The proceeds are to be used in extensions to the power station. It is stated that the plant will supply power to a new interurban road to be built from Fremont to Tiffin.

CINCINNATI, OHIO.—The Cincinnati Gas & Electric Company is negotiating with the city authorities to secure a new lighting contract with the city, and to install new arc lamps having 50 per cent higher candle power than those now in use. The company has arranged to install the new lamps on one circuit and the city will investigate the company's claims for superiority for these lamps.

TIFFIN, OHIO.—The Consolidated Gas & Electric Company and the Tiffin Edison Electric Illuminating Company have submitted identical bids each for illuminating a different portion of the city. They proposed to furnish eighty 2,000 candle-power lamps for ten years at $75 per lamp, with additional lamps at $70 each or under a five year contract at $77.50 and $72.50 respectively. The city has rejected the bids.

CINCINNATI, OHIO.—The stockholders of the Cincinnati Gas & Electric Company will meet June 25 to pass on the proposition of leasing the property to the Consolidated Gas & Electric Company on a guarantee dividend basis. The new company has deposited $3,000,000 guarantee for payment of dividends and $2,000,000, which will be expended in improvements to the property during the next five years.

BRYAN, OHIO.—General Manager E. E. Darrow, of the Toledo & Indiana Railway Company has submitted a proposition to the city to furnish energy for commercial lamps at 2½ cents per unit, and for street lamps at $33 per year, the city to install, own and maintain its lines and lamps. The city is considering a proposition to issue $30,000 worth of bonds for the purpose of installing an electric light plant in the water works plant, but this will not be passed upon until the other one can be investigated.

TOLEDO, OHIO.—J. N. Gardner, president of the Gardner Construction Company, which is now in charge of the financing and construction of the proposed Cincinnati, Toledo & Detroit Short line, has returned from Europe and says he has interested European capitalists in the purchase of $6,000,000 of bonds necessary to build the road. Construction work on the line will be started again this Fall. The proposition contemplates a road across Western Ohio from Toledo to Cincinnati by the way of the western tier of counties. The project has been talked of for some years, and a small amount of work has been done between Napoleon and Defiance.

FREDERICK, OKLA.—The new electric lighting plant has been completed and is now in operation.

COTTAGE CITY, ORE.—The Willamette Valley Company has petitioned City Council for a thirty-year electric light franchise.

DAYTON, ORE.—The citizens of this village are considering the question of constructing an electric lighting plant.

PORTLAND, ORE.—The Council has reported favorably on the ordinance granting the American Investment Company a franchise to construct, maintain and operate steam pipes, cold air pipes, wires and conduits, for the transmission of heat, power and light, and to operate cold storage plants; cost of plant proposed is $500,000.

CONNELLSVILLE, PA.—The City Council has awarded a contract for the installation of an electric fire alarm system.

LOCK HAVEN, PA.—The Lock Haven Electric Light & Power Company is making extensive additions to its plant, and when completed will establish a day power circuit.

WLKESBARRE, PA.—A new electric plant has recently been installed in the plant of the Hazard Rope Works for the purpose of operating the machinery by electricity.

BOONEVILLE, PA.—The Sugar Valley Telephone Company has applied for a charter, and has ordered materials to construct a telephone line from Tylersville to the county seat.

KENNETT, PA.—New York capitalists have secured a controlling interest in the White Clay Creek Supply Company, which operates the electric lamps in Kennett and vicinity, with power houses in this city and at Rosedale, Del.

CONNELLSVILLE, PA.—Two new charters have been approved by the Governor for the West Penn Railways Company. The charters cover Gallatin Avenue and Broadway, Uniontown, and will open the way for more lines for the West Penn system. The company will ask for franchises from Uniontown at once. The Gallatin Avenue line in Uniontown will be used to build a line to Leisenring No. 3 and that vicinity, while the Broadway charter will be used to connect Brownsville and Uniontown by an electric line.

BATESBURG, S. C.—The municipal electric light plant, which has been in operation eighteen months, is giving entire satisfaction, and has proved more than self-sustaining.

WALHALLA, S. C.—Frank Head, representing Head & Company, bankers of Louisville, Ky., has purchased the entire issue of $250,000 bonds of the Oconee Water, Light & Power Company of this city. The company supplies electric power to five towns in South Carolina. The sale was made by Mayor James Thompson and associates.

GREENVILLE, S. C.—Owing to the electric power plant of the Anderson Water, Light & Power Company, located at Portman, 8 miles from Anderson, S. C., being damaged by fire resulting from a bolt of lightning, the cotton mills and other industrial plants which were operated with power from the plant were forced to shut down temporarily, but most of them will be able to resume operations at once, arrangements for power having been made with auxiliary plants in the city. Street and incandescent lamps are being supplied in Anderson from the company's auxiliary station located in the city.

PIERRE, S. D.—The City Council has granted a franchise to Noah Newbanks, of this city, and Frank Fischer, of Fort Pierre, S. D., to operate a street railway in this city.

ATHENS, TENN.—The Athens Electric Light Company is preparing to make an addition to its power house.

SPARTA, TENN.—The Gainesboro Telephone Company will issue bonds to the amount of $100,000 for extensions and improvements to its system. Joel H. Anderson is general manager.

SALT LAKE CITY, UTAH.—The principal holdings of the Mormon Church in the Utah Light & Railway Company are to be taken over by a $25,000,0000 corporation composed of English and American capitalists. It will be known as the Inter-Mountain Consolidated Railroad Company. It is said that the new company will also acquire the Ogden Street Railway. It is also announced that the Salt Lake & Los Angeles Railroad, another church property, has been sold to a local syndicate for $500,000.

BURLINGTON, VT.—The city treasurer has been authorized to sell on June 15, $171,000 bonds, of which $39,000 are for improvements to the electric light plant.

FT. ETHAN ALLEN, VT.—Bids will be received until June 15 by Capt. W. E. Cote, Construction Quartermaster, U. S. A., Burlington, for furnishing and installing electric fixtures and service connections in Administration building at Ft. Ethan Allen.

MANASSAS, VA.—The citizens have voted to issue bonds for $50,000 for electric light, sewer and street improvements, and will soon ask for proposals for the work.

RICHMOND, VA.—The large power plant of the Virginia Passenger & Power Company on the upper Appomattox River is nearly completed, and is expected to be in operation by June 15 at the latest.

SPOKANE, WASH.—A branch line of the Spokane & Inland Railway to connect the line now building to Palouse City with the Colfax line is projected.

SEATTLE, WASH.—H. F. Grant, manager Seattle Electric Company, writes that Stone & Webster, of Boston, Mass., are engineers in charge of the improvements contemplated.

NORTH YAKIMA, WASH.—J. C. Brooker, City Clerk, writes that there is talk of calling a special election this summer to vote on the question of constructing water works and an electric light plant, but nothing definite has yet been done. A. H. Nicol, City Engr.

SUNNYSIDE, WASH.—H. W. Turner, Town Clerk, writes that bids have not yet been asked for the proposed water works and electric light plant, to cost $10,000. The committee consists of W. B. Bridgman, W. B. Cloud and William Hitchcock. Engineer, Prof. O. L. Waller, of Pullman.

WATERFORD, WIS.—The Waterford Milling Company is getting the material and has started the work of installing an electric lighting plant to supply the village of Waterford with electricity for lamps.

HAMILTON, ONT.—The East Incline Railroad was put out of business by the burning of its power plant and shops.

FORT SASKATCHEWAN, CAN.—O. H. Higman has received a 15-year franchise from the town to light the street and supply power. He will shortly commence the erection of a plant.

OTTAWA, ONT.—The Bell Telephone Company has offered to pay the city $5,000 annually for a 5-year extension of its franchise and offers business telephones for $45 and residence telephones for $25 per annum.

EUGENIA, ONT.—Rowan & Elliott, of St. Catherines, Ont., have the contract for the tunnel construction in connection with the proposed power plant of the Georgian Bay Power Company. Other contracts, bids for which will be called for shortly, include 3,500 feet of pressure pipe, dam, embankment and power house construction. Engineer, H. von Schon, of Detroit, Mich.

WINNIPEG, MAN.—The Fire, Water and Light Committee has withdrawn its call for tenders for electric generating apparatus for the high service water works (bids for which were to have been opened on June 4) having made other arrangements for securing electric power.

RIGAUD, QUE.—The Town Council is considering a proposition for the erection of an electric light plant.

New Industrial Companies.

THE STANDARD ELECTRIC SUPPLY COMPANY has been organized at Charlotte, N. C., and has bought out the stock of the Standard Electric Co.

THE CHARLOTTETOWN ELECTRIC & TRANSIT POWER COMPANY has applied for incorporation with a capital of $50,000 to carry on a general electrical supply business.

THE ELECTRICAL CONSTRUCTION COMPANY, of London, Ont., has applied for incorporation, with a capital of $100,000. The object of the company is to manufacture electric signs, etc.

THE CUMBERLAND LAND & COLONIZATION COMPANY, of Rome, Ga., has been incorporated by J. R. Deal and others, to engage in various lines of business, including the generating and transmission of electric power.

THE NATIONAL AMERICAN TELEPHONE COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $1,000, for the purpose of manufacturing telephones, etc. The incorporators are W. R. Lea, O. C. Meyer and E. R. Lea.

THE IGNITER APPLIANCE COMPANY, of Cleveland, Ohio, has been incorporated by C. W. Hunt, W. C. Hine, R. W. Hine, P. G. Kassulker and W. W. Tremaine, with a capital stock of $10,000. The company will manufacture ignition devices.

ZOBEL & MAKIN ELECTRIC MANUFACTURING COMPANY, of Johnstown, Pa., has been chartered with a capital stock of $10,000. The purpose of the company is to manufacture miniature lamps. The directors are John Zobel, Carl A. Zobel and Alvie O. Makin.

THE STANDARD ELECTRIC ACCUMULATOR COMPANY, of New Brunswick, N. J., has been incorporated with a capital stock of $1,500,000. The incorporators are Edgar T. Barcalow, Frank R. Jones and Edward Morris. The company will manufacture and deal in electric appliances.

THE MULLER POROUS PLATE ACCUMULATOR COMPANY, of New York, N. Y., has been incorporated with a capital stock of $5,000. The company propose to manufacture electric storage batteries. The directors are Frank Assmus, of Mt. Vernon; Albert Muller and J. F. Joyce, of New York.

THE BANNER ELECTRIC COMPANY, of Youngstown, O., has recently elected the following officers: W. B. Carr, president; C. F. Cook, vice-president; N. L. Noris, secretary and manager; O. U. Cassady, treasurer. A dividend of 8 per cent on common and preferred stock was ordered payable quarterly. During the year just ended 750,000 incandescent lamps were manufactured. This year the output will be a 1,000,000 lamps. The company is now using its new plant on Market Street, where it has a much enlarged capacity.

THE ENAMELED PIPE & ENGINEERING COMPANY, of Cleveland, O., have been incorporated with $50,000 capital stock. Incorporators are: R. F. Nailler, D. H. Sell, J. B. Looker, N. O. Mather and Osborne Esgate. The company will manufacture an enamel which it is claimed by its inventors will prevent electrolysis and which is the invention of R. F. Nailler an electrician of this city, and F. P. Summers, of Cleveland, patentees of the system. The plant for the manufacture of the enameled pipe, pumps and fittings which the company will put out will be located in Cleveland. The company will also do a general engineering, designing, consulting and constructing business and now has two large contracts for mining machinery in the West.

Legal.

NEW YORK TELEPHONES.—Commissioner Ellison of the Department of Water Supply, Gas and Electricity in behalf of the New York Electric Lines Company, one of the subsidiary companies of the Great Eastern Telephone Company, has been served with a writ of mandamus to compel him to issue a permit to begin the construction of its conduit system, under a franchise granted to the company in 1883 by the Board of Aldermen. The company is represented by ex-Chief Justice Alton B. Parker, assisted by Charles W. Dayton, J. Aspinwall Hodge, Frank B. Vermilye, Tracey C. Becker, of Buffalo, and the firm of Black, Olcott, Gruber & Bonynge, of this city. The Electric Lines Company alleges that it has never ceased to do business, and that during the time complained of by the telephone interests opposing the grant of the permit the company was active.

Obituary.

MR. W. T. BOUCHELLE.—We regret to note the death of Mr. William T. Bouchelle, assistant to the president of the New York Telephone Company, at his home in Greenwich, Conn., on May 19. He entered the service of the company in 1884 and his connection with it continued steadily for 22 years. For 17 years he was in the executive office as confidential secretary and assistant to President Cutler, in which capacities he won universal esteem by his devotion to duty and his personal characteristics. The funeral took place on the afternoon of May 22 at Greenwich, when the executive offices of the company were closed as a mark of respect to his memory.

Personal.

FRANK B. CHESTER, of Bowling Green, Mo., manager of the Wood Company Telephone Company, has resigned and has been succeeded by W. H. Wallace.

MR. A. M. HUNT is secretary of the San Francisco Citizens' Committee on Light & Power, which has a large amount of important work committed to its care in the devastated city.

MR. W. C. L. EGLIN, of the Philadelphia Electric Company, and secretary of the National Electric Light Association, has sustained a severe bereavement in the death of his mother.

MR. LESTER W. COLLINS, superintendent of the Leominster Electric Light & Power Company has resigned to accept a position with a Boston electric concern. Mr. Charles M. Young, of New York, has been selected to fill the vacancy.

DR. E. F. ROEBER has brought out in pamphlet form his very interesting paper on the themo-dynamics of the electric incandescent lamp, which, with demonstrations, he read before the American Electro-Chemical Society last year. It is accompanied by the discussion.

MR. L. S. GREENLEAF has been appointed general manager of the Hudson River Telephone Company to succeed the late Henry Hawley. Mr. Hiram T. Stevens of Syracuse has been elected vice-president and Mr. B. C. Woolverton, also of Syracuse, chief engineer.

MR. V. C. GILPIN, well known as a manufacturers' agent in the electrical field, has recently taken over the agency for the American Conduit Manufacturing Company, whose sales he will control in the metropolitan district with offices at 120 Liberty Street, New York City.

MR. C. L. EDGAR, president of the Boston Electric Company, accompanied by Mrs. Edgar, has sailed this week for England, to perform his duties as a member of the public ownership commission appointed by the National Civic Federation. He will be gone several weeks.

MR. W. J. CLARK, manager of the foreign department of the General Electric Company, has sailed this week for Europe. While on the other side it is his intention to devote some time to the municipal ownership and operation inquiry now being conducted by the National Civic Federation.

MR. E. H. SMYTHE, for several years in the patent department of the Western Electric Company, and recently in the engineering departments of the Central Union Telephone Company and the Chicago Telephone Company, has opened offices in the Monadnock Block, Chicago, as a patent expert.

MR. GEORGE L. COLGATE, of Batavia, N. Y., as consulting engineer for the Eastern Monroe Electric Light & Gas Company, is making plans for the erection of a power plant with a capacity of 10,000 horsepower. His specifications calls for three turbo-generators of 2,500 kw each, with attendant condensers, boilers, economizers, etc. The plant will be operated at 4,400 volts, 60 cycles, three phase.

MR. F. NICHOLLS, first vice-president of the Electrical Development Company of Niagara Falls, laid a cornerstone of the new power house, on the Canadian side of the river on May 8. Another stone was laid by Sir H. Pellatt, the president of the company, and a third by Sir W. M. Clark, lieutenant-governor of the Province of Ontario. The party then made a trip through the 2,200-ft. tunnel discharging under the great cataract.

MR. GEORGE J. WELLINGTON, consulting and contracting electrical engineer of San Francisco, informs us that his offices were completely gutted by fire but that the organization remained intact. Since the first Sunday after the fire his firm has been occupying temporary offices in the same Kohl Building which had not been altogether destroyed. Since that time active work has been done in preparing for the coming reconstruction of the city.

MR. T. A. EDISON.—Advices from Orange, N. J., state that Mr. Thomas A. Edison, accompanied by his brother-in-law, J. N. Miller, Frederick Ott and George Poppe, has started on a long trip in two automobiles. The party carried a complete camping outfit and all will have a spell of outdoor life. Their destination is North Carolina for prospecting. Messrs. Miller and Ott will be the cooks, it not being deemed safe to allow Mr. Edison to turn his inventive faculties loose when it comes to providing meals. The party will forage as it travels.

DR. FRANCES W. MONELL, the electro-therapist, gave an "electrical tea," with the cooperation of the New York Edison Company, on May 19, to some three hundred club women and others, at her apartments in Ivy Court. All the refreshments were cooked electrically, the illuminations and special features of interest were electrical, and the whole affair was a highly successful demonstration of the social and domestic availability of the electric current and its modern appliances. It is by such functions that the utility of electricity can best be made convincing.

MR. E. ROSEWATER.—Mr. Edward Rosewater, veteran editor of the *Omaha Bee*, and the best known Republican politician in the West, has announced in his own newspaper his candidacy for the United States Senate, to succeed Senator Millard. In his announcement Mr. Rosewater calls attention to the fact that he has advocated for many years the principles now held by President Roosevelt. Mr. Rosewater has been in Rome as the representative of the United States at the International Postal Congress. He has long been an antagonist of the railroad in politics and is a national figure. During the war he was a telegraph operator in the

White House and was one of the pioneers in the development of Nebraska.

MR. H. C. BAKER, formerly in charge of the Atlanta territory of the Crocker-Wheeler Company, in which capacity he became well known as an electrical engineer throughout the Southern industrial field, has started for San Francisco, where he will take charge of the Pacific Coast territory of the Crocker-Wheeler Company. The offices at Fremont and Howard Streets, San Francisco, were completely destroyed by the recent fire; temporary offices have been established at 2611 Broadway. Mr. Baker will enter an active field of electrical development in which the company is already conspicuously established by its installation of 4,000 kw alternating-current generators in the plant of the California Gas & Electric Corporation. These machines, the largest gas-engine-driven alternators in the world, escaped damage in the recent disaster.

MR. JOHN I. BEGGS.—In recognition of his services as trustee of the National Electric Company, the department heads of the newly formed National Brake and Electric Company have presented John I. Beggs with a bronze tablet. The tablet bears the following inscription: "Presented to John I. Beggs, trustee of the National Electric Company, Milwaukee, by the officers of the company as a mark of esteem of the manner in which he handled the company and its employees during the twelve months the National Electric Company was under his management, April 1905, March, 1906." The names inscribed upon the tablet are J. H. Denton, general superintendent; R. P. Tell, secretary and treasurer; J. L. Wailes, general sales manager; and W. L. Waters, chief engineer. Mr. Beggs has also been presented with a testimonial in the form of a leather-bound album from the employees of the Twelfth Street Station. The album contains the autographs of the employees, together with an apprciation of the fact that their wages were voluntarily raised by the president.

MR. W. S. BARSTOW.—The announcement of the incorporation of the engineering firm of W. S. Barstow & Co., with offices at 56 Pine Street, New York City, and Failing Building, Portland, Ore., is looked upon in electrical circles as a natural outcome of the enormous development in transmission and lighting which has set in on the Pacific Coast. Mr. Barstow, who has in recent years been closely identified with this work, has now secured the co-operation in the new company of Mr. J. B. Taylor, late with Westinghouse, Church, Kerr & Co., and Mr. R. L. Donald, late with the Southern Pacific Railroad. This strong combination will undertake the complete designing and construction of electric lighting, railway and power plants and distributing systems; the designing and construction of industrial plants; supervision and management of electrical properties; special reports and examinations on operation, improvement and extension of existing installations. Within the last week it has booked orders for seven important installations running into millions of dollars. Mr. Barstow, who was at one time prominent in the electric lighting field, and manager of the great Edison system in Brooklyn, is at present the president of the New York Electrical Society.

News of the Trade.

DODGE & DAY, engineers, Philadelphia, announce the recent removal of their offices to Drexel Building, Suite 597.

THE PENN HARDWARE COMPANY, Reading, Pa., is installing a 150-hp Koerting gas engine to be run on producer gas furnished by a Koerting suction producer. The entire plant is supplied by the De La Vergne Machine Co., New York.

THE STANLEY-G. I. ELECTRIC MFG. COMPANY'S San Francisco office now occupying temporary quarters in the Blake Block, Oakland, announces that it will move next week into Rooms 403, 404 and 405 Atlas Building, 604 Mission Street, San Francisco.

ALLIS-CHALMERS COMPANY.—In addition to the office recently established at 906 Broadway, Oakland, Cal., the company has now opened quarters in the Atlas Building, 602 Mission Street, San Francisco, where its staff is ready also for the transaction of business.

IMPERIAL SOLDERING STICK.—The Standard Chemical Company, Cincinnati, O., is placing on the market a soldering flux under the name "Imperial Soldering Stick." It consists of a ¾-inch cylinder 5 inches long covered with tin-foil and enclosed in a cylindrical wooden receptacle.

THE WAGNER ELECTRIC MFG. COMPANY, of St. Louis, Mo., has purchased a tract of land lying between the River des Peres and the Wabash Railroad Avenue, the consideration named being $24,000. Preparations are being made by the company to build a factory on the tract.

FORT WAYNE ELECTRIC WORKS have established temporary offices for the Pacific Coast at 62 Blake Block, Oakland, Cal., but will later occupy rooms 403-4-5 Atlas Building, San Francisco, as soon as that structure is ready for occupancy. The concern has also replaced its stock, which was destroyed by fire.

THE AMERICAN AXLE WORKS, of Philadelphia, have found that the demand for their product greatly exceeds their present output. They have engaged Dodge & Day, engineers, of Philadelphia, to investigate the condition of their plant, and report on just what changes should be made to their present layout and what additional building should be undertaken to enable them to increase their capacity about fifty per cent.

GENERAL STORAGE BATTERY COMPANY, of 42 Broadway, New York City, will make an exhibit of the Bijur cell at the coming convention of the National Electric Light Association at Atlantic City on Young's Pier and at the immediately succeeding convention of the Master Car Builders and Master Mechanics Association on the Steel Pier. This exhibit will follow the general lines of that made at the recent Chicago Electrical Trades Exposition.

ELECTRIC WIRING COMPANY, 106 East Eighth Street, Kansas City, Mo., wishes to receive catalogues and price lists as to staples and specialties. It has contracts in hand for the new Shubert Theatre, Elks Club, Kansas City Athletic Club, Langdon Hospital, Metropolitan offices, etc. It will carry a stock of lighting and decorative fixtures, and will give special attention to problems of illuminative engineering. It is equipped to supply plans, specifications and estimates for anything in the lines indicated.

YEARSLEY, LEVINE & CO.—Yearsley & Levine have recently sold an interest in their business to Mr. Richard Scheinert, formerly with the Public Service Corporation of Camden, N. J., and Mr. Scheinert has also joined the firm under the name of Yearsley, Levine & Co., in the capacity of superintendent. The firm have taken much larger quarters at 211 North Third Street, Philadelphia, where they will display their very extensive stock of second-hand electrical machinery, and where they will be glad to deal with prospective purchasers.

LATHE IN OPERATION.—During the Master Car Builders' and Master Mechanics' Conventions to be held at Atlantic City, June 13-20, the Niles-Bement-Pond Company will have on exhibition and in full operation one of its extra heavy 90-inch driving wheel chucking lathes. This will afford an exceptional opportunity to observe this machine at work. Owing to its great weight, this machine cannot be shown on the Steel Pier. The company has therefore built a special booth, two minutes' walk south from Pennsylvania Station on New York Avenue, near Atlantic Avenue, where all are cordially invited to witness a demonstration of this machine.

NORTHERN MOTORS.—The installation of electric power equipment in certain classes of service necessitates that the machines be totally enclosed so as to be dust proof or be protected to exclude flying pieces. In cases where electric machines are to be installed for such service the Northern Electrical Mfg. Co., Madison, Wis., applies dust proof or protecting covers which not only afford the requisite protection against dust or other materials, but are readily removed, thus making it easy to inspect the running parts. This insures the satisfactory operation of Northern protected and dust proof machines in all classes of service. The Northern Company frequently employs direct-current motors for operation in wet locations where provision has to be made not only for the exclusion of moisture, but water. This is successfully accomplished by the Northern design.

THE PELTON WATER WHEEL COMPANY.—This company deems itself particularly fortunate, notwithstanding the complete destruction of its works in the recent disaster at San Francisco. In the three hours prior to the burning of its works, it succeeded in saving all commercial books, complete cost memoranda and the greater part of the original tracings, together with several years' correspondence. The new San Francisco plant of the company which had been under construction for a couple of months prior to the fire, is outside the fire zone. A large force is now at work and the company expects to be installed in its new location by the middle of July of this year. A complete equipment of modern machine tools is already on the way, and machine shop facilities will be even better than before the disaster. The Pelton Water Wheel Company has temporary offices at 1259 Alice St., Oakland, Cal., but will be permanently located in the Monadnock Building, San Francisco, after June 15.

MEAD-MORRISON MFG. COMPANY is the successor to the firm of that name and the Rawson & Morrison Mfg. Company with which it has consolidated. The staff of the latter concern will be retained and the business will be continued along the old lines of product in hoisting engines, derrick swingers, electric hoists, belt hoists, suspension cableways, cable roads, etc., inclusive of all kinds of machinery for handling coal and other bulky materials. The capital is $1,000,000 and the headquarters are at Cambridge, Mass. The officers are: Eugene N. Foss, president; William J. Selleck, vice-president; John G. Morrison, treasurer; Willard S. Martin, general manager; Orton G. Dale, New York manager; Gust. Pers. Wern, manager of engine department; Almon E. Norris, chief engineer; Frederick W. Scott, superintendent. Directors: Eugene N. Foss, Boston, Mass.; John G. Morrison, Cambridge, Mass.; Willard S. Martin, Cambridge, Mass.; Arthur P. French, Boston, Mass.; Benjamin D. Brown, New York; William J. Hoyt, Manchester, N. H.

125-TON ENGINE BED PLATE.—The progress of the huge 125-ton engine slide and bed plate casting which was poured over two weeks ago at West Allis Works of the Allis-Chalmers Company, is attracting universal interest from the fact that it is the largest single casting ever poured in the company's works during an engine building career of more than a quarter of a century. The casting, which was taken from its mould on April 24, weighs, roughly, 133 tons. Three heavy traveling cranes, whose aggregate capacity is 145 tons, will be used in conjunction to lift the casting from the pit in the floor of the foundry and place it ready for the process of cleaning, which will require the work of ten men in two shifts. So heavy is this single piece, that instead of attempting anything but a straight lift with the cranes, specially laid railroad tracks will be provided to bring directly to the side of the casting, a special flat car built for the purpose of handling this piece. This car has 16 wheels and is the largest of its kind ever built. The same car used to transport the casting from the foundry to the machine shop No. 1, where it will be subjected to machining processes necessary to finish it, will afterwards carry the finished piece to its destination. At the present time, it is the intention to convey the casting directly to Machine Shop No. 1, where the heaviest machine tools are located. The casting will be bolted to the floor and machine tools used in the finishing will be brought to it.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MAY 15, 1906.
[Conducted by Rosenbaum & Stockbridge, Pat. Atty's, 140 Nassau St.,N.Y.]

820,407. ELECTRIC RAILWAY; John A. Garey, Tarkio, Mo. App. filed May 23, 1905. A form of collector shoe for electric railways having a frame guided in the usual conduit slot, and which carries spring-pressed rollers for engaging the usual conductors. An air blast is provided for cleaning the conduit in advance of the shoe.

820,411. RAILWAY SIGNALING SYSTEM; Henry W. Griffin, New York, N. Y. App. filed Jan. 18, 1905. A complete block signal system of the overlap type adapted to display danger and caution signals. The track rails are divided into insulated sections charged with di ect-current potential, and polarized relays are included for securing t ie overlap feature.

820,412. RAILWAY SIGNAL SYSTEM; Henry W. Griffin, New York, N. Y. App. filed Jan. 31, 1905. Relates to modifications of the above.

820,413. RAILWAY SIGNALING SYSTEM; Henry W. Griffin, New York, N. Y. App. filed Feb. 28, 1905. Another form of block signal having substantially all of the above mentioned features.

820,421. ELECTRICAL CIRCUIT BREAKER; Charles F. Hutchings, Bay City, Mich. App. filed Oct. 14, 1903. A circuit breaker having a knife blade switch which is spring impelled into circuit opening relation, but which is normally restrained against such movement by a solenoid. The solenoid is differently wound so as to open the cut-out whenever the magnetic field thereof is shifted due to a short circuit on the line or in the motor.

820,423. TROLLEY FOR OVERHEAD TROLLEY SYSTEMS; Ezra F. Landis, La Salle, N. Y. App. filed Feb. 20, 1905. The usual trolley wheel is completely covered by protecting housing except for a slot where the wheel engages the wire. At this point a pair of spring shoes are arranged to normally close over the wire.

820,432. TELEPHONE-SWITCH; William E. McCormick, Chicago, Ill. App. filed Aug. 26, 1901.

820,440. TROLLEY POLE; Robert P. Rever, Newark, N. J. App. filed Feb. 18, 1905. In order to impart greater flexibility to a trolley pole, the pole is made with a pivot joint and has spring wires or blades incorporated in it so as to hold the two sections in alignment.

820,463. ATTACHMENT FOR TELEPHONE RECEIVERS; Casper Zimmerman, Aberdeen, S. D. App. filed Nov. 4, 1905.

820,464. SELF-ACTING ELECTRICAL ROPE-STRAINING DEVICE; Otto Adam, Dresden, Germany. App. filed Feb. 16, 1905. An apparatus for coaling ships at sea, comprising a cable which is stretched over pulleys on the respective ships and may be tightened by a small motor-driven windlass. The latter is set in operation by a centrifugal device moved by the cable to be tightened.

820,481. TROLLEY; Jacob R. Deily, Philadelphia, Pa. App. filed Sept 5, 1905. The usual harp has a yoke swiveled therein on which are journaled two trolley wheels so as to give a better contact with the trolley wire, and to lessen the liability of the pole leaving the wire.

820,482. APPARATUS FOR TREATING LIQUIDS; Leon Dion, N. Y. App. filed May 24, 1904.

820,489. BALLAST DEVICE FOR NERNST LAMPS; Ludwig Glaser, Berlin, Germany. App. filed June 8, 1905. In order to overcome the defect of iron ballast when used with second-class conductors of large cross-section, due to the fact that the iron does not glow soon enough, the patentee makes use of a supplemental iron filament which initially takes all the current, and becomes heated, and when the main filament or ballast is sufficiently heated thereby, this is automatically cut into circuit.

820,491. ELECTRIC SWITCH; David E. Gray, New York, N. Y. App. filed Feb. 21, 1905. Has means for electrically connecting two of the contact members of the switch when the third contact is engaged by the switch arm.

820,496. AUTOMATIC CIRCUIT BREAKER; Dag Hoyem, Brooklyn, N. Y. App. filed Oct. 24, 1904. Details of construction of a magnetic circuit breaker which is designed to be sensitive to the tripping action, which is opened positively by a spring, and which is closed by a toggle action.

820,498. ELEVATOR CONTROL SYSTEM; John D. Ihlder, New York, N. Y. App. filed Feb. 16, 1905. A complete diagram of circuits for an electric elevator of the push button type, in other words, in which the movements are controlled from different floors by push buttons thereon.

820,499. ELECTRIC ELEVATOR CONTROL SYSTEM; John D. Ihlder, New York, N. Y. App. filed Mar. 13, 1905. Relates to additional features of the above and particularly to means by which the elevator is brought to rest at exactly the same point regardless of variations of load, speed, or direction of travel.

820,504. CONTROLLER FOR ELECTRIC MOTORS; Alvaro S. Krotz, Springfield, O. App. filed Nov. 4, 1904. Details for a controller especially adapted for use with electric vehicles. The patent includes the mechanical features and also the arrangement of circuits of a controller adopted for a storage battery and two motors.

820,521. ELECTRICAL PROTECTIVE DEVICE; Charles A. Rolfe, Adrian, Mich. App. filed June 22, 1903. A graphite pencil is included in the electric circuit to be protected and a mercury thermometer has its bulb embedded in the graphite. The rise of temperature due to excessive current expands the mercury until the latter closes a ground circuit.

820,529. AUTOMATIC TRAIN REPORTING SYSTEM; Elmer E. Steiner, Knightstown, Ind. App. filed July 10, 1905. Depressible tappets are provided at points along the track so as to be engaged by specially constructed shoes carried by the train. The latter have a plurality of projecting lugs spaced in a special and predetermined way for each train so as to give a distinctive signal when passing over the tappets.

820,539. RAILWAY; Alpheus H. Wood, Ann Arbor, Mich. App. filed Sept. 11, 1905. An inclined bearer fixed at a point along the roadway operates to raise a shoe or tappet depending from the train, and which serves to operate an electric switch on the car. The purpose is not stated.

820,555. RECOVERY OF COPPER FROM SOLUTIONS CONTAINING IT; Benvenuto Comba, Turin, Italy. App. filed Sept. 14, 1903.

820,574. ELECTRIC FURNACE; James E. Hewes, Plattsburg, N. Y. App. filed July 18, 1905.

820,584. TROLLEY POLE CONTROLLER; Joseph F. Mackin, Columbus, O. App. filed Aug. 21, 1905. A pneumatic means for retrieving a trolley pole. A sleeve and rod are so arranged that when their motion is slow they do not bind with respect to one another, but in case of a quick relative movement, the sleeve binds and a valve is opened which admits air to retrieve the pole.

820,604. ELECTRIC COUPLING; Otto Schaller, Steglitz, near Berlin, Germany. App. filed June 1, 1905. In order to avoid danger to employees when making the electrical connections in a train, the conductors are enclosed in tubes similar to the usual air brake tubes and having clasps also generally similar. The electric circuit cannot be completed with the power terminals until the tubes are properly clasped together.

820,641. PROTECTOR FOR INSULATORS; John L. Gleason, Boston, Mass. App. filed Feb. 17, 1904. A form of molding, and particularly the corner connection therefor to be used with electric wiring. The corner boxes are shaped in quarter cylindrical form and have notches for the reception of the molding along their edges.

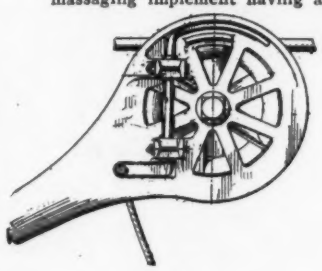
820,649. ELECTRIC MACHINE AND SYSTEM; Frederick W. Knopfe, St. Louis, Mo. App. filed Aug. 25, 1904.

820,652. TELEGRAPHIC SYSTEM; Jacob W. Lattig, West Bethlehem, Charles L. Goodrum, Philadelphia, Pa., and Edward E. Clement, Washington, D. C. App. filed June 9, 1903. A wireless telegraph system particularly adapted for trains. A plurality of stations are located along the track each capable of emanating or receiving wireless waves. The stations may be automatically actuated by an ordinary telegraph line from the central or train despatcher's office.

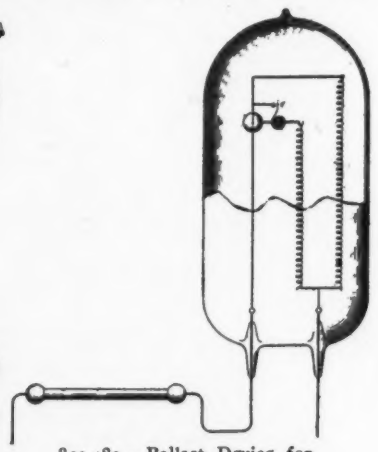
820,656. OZONE-VENTILATOR; Frederic De Mare, Brussels, Belgium. App. filed Sept. 23, 1904.

820,700. FIRE-ALARM BOX; Loudoun Campbell and Frank G. Campbell, Washington, D. C. App. filed Apr. 4, 1905. In order to prevent the possibility of a fire alarm not being given by ignorant persons who mistake the usual local bell for the alarm, the patentee proposes to have the usual local bell in an electric circuit so arranged that the local bell is rung simultaneously with the fire alarm proper.

820,753. ELECTRICAL VIBRATORY MOTOR; James L. Adams, Jr., Springfield, Ill. App. filed Mar. 24, 1905. Mechanical details of a massaging implement having an armature which moves to and fro between electro-magnets of special form having angular pole faces. The armature is supported by conducting springs through which the current is supplied thereto.



820,423.—Trolley for Overhead Trolley Systems.



820,489.—Ballast Device for Nernst Lamps.

820,604. ELECTRIC COUPLING; Otto Schaller, Steglitz, near Berlin, Germany. App. filed June 1, 1905. In order to avoid danger to employees when making the electrical connections in a train, the conductors are enclosed in tubes similar to the usual air brake tubes and having clasps also generally similar. The electric circuit cannot be completed with the power terminals until the tubes are properly clasped together.

820,755. ENERGY METER FOR THREE-PHASE PLANTS UNSYMMETRICALLY LOADED; Riccardo Arno, Milan, Italy. App. filed Sept. 20, 1902. A device for measuring the energy in a three-phase system which is unsymmetrically loaded. Has two series coils, two shunt coils, and a compensating coil in series with each shunt coil, and means for impressing each shunt coil with an electro-motive force which is displaced in phase with relation to normal electro-motive force between the corresponding leads of the three-phase system.

820,756. ALTERNATING CURRENT METER; Riccardo Arno, Milan, Italy. App. filed Feb. 10, 1904. Relates to modifications of the above particularly adapted to single-phase alternating-current circuits.

820,781. SUSPENDED ELECTRICAL DENTAL MOTOR; John F. Hammond, Brewster, N. Y. App. filed Apr. 27, 1905. The motor is flexibly suspended from a horizontal arm or crane, and is carried on trunnions so as to be capable of assuming any position. The motor has the usual flexible shaft connection with the dental tool.

820,803. TWO-DIVISION TELEPHONE SYSTEM; John H. Lendi, Chicago, Ill. App. filed Oct. 27, 1902.

820,823. ELECTRICAL FIRE ALARM APPARATUS; James P. Robertson, North Sydney, Near Sydney, New South Wales, Australia. App. filed July 17, 1903. A thermostat operated fire alarm adapted to operate in conjunction with a central alarm system. Has various indicators for showing the location of the fire and also for showing whether the automatic sprinklers are in operative condition.

820,877. CONTROLLER FOR ELECTRIC CIRCUITS; Sam H. Kanmacher, Schenectady, N. Y. App. filed June 22, 1904. Has a single spring connected directly to the switch to hold it normally in off position and a lost motion connection between the switch and the distant controlled device to permit the desired movement to the switch without disturbing said device.

820,890. ALTERNATING CURRENT MOTOR; Adolph W. Schramm, Philadelphia, Pa. App. filed May 20, 1905.

820,924. INSULATOR FOR HIGH-TENSION LINES; Emil Giraud, Paris, France. App. filed Oct. 1, 1904. The usual hangers are fixed to tubes swiveled upon the guy or cross wires and the tube has arms which ground the conductor in case the wire breaks and causes the tube to be angularly displaced.